Electrical World

The consolidation of Electrical World and Engineer and American Electrician.

Vol. 57. NEW YORK, THURSDAY, APRIL 13, 1911. No. 15.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

239 West Thirty-ninth Street, New York.

James H. McGraw, President.
Hugh M. Wilson, 1st Vice-President. A. E. Clifford, 2d Vice-President.
Curtis E. Whittlesey, Secretary and Treasurer.
Telephone Call: 4700 Bryant. Cable Address: Electrical, New York

Editor.....W. D. Weaver
A. S. M'Allister.....Associate Editor
W. H. Onken, Jr.....Associate Editor
W. E. Keily.....Associate Editor
O. H. Caldwell.....Assistant Editor
G. Tisell.....Assistant Editor
W. M. Finley.....News Editor
S. S. Boies.....News Editor
Frederic Nicholas.....Special Contributor
J. R. Cravath.....Special Contributor

Chicago Office.....1570 Old Colony Building
Cleveland Office.....1021 Schofield Building
Philadelphia Office.....Real Estate Trust Building
European Office.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico, $3.00 per year; Canada, $4.50 per year. All other countries, $6.00 per year. Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. Date on wrapper indicates the month at the end of which subscription expires.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday of the week of issue.

Copyright, 1911, by McGraw Publishing Company.

Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World for 1910 *was* 974,750. *Of this issue* 17,750 *copies are printed.*

NEW YORK, THURSDAY, APRIL 13, 1911.

CONTENTS.

Editorial 891
Central-Station Statistics..... 894
Technical Students at Foreign Schools..... 894
Sale of Toronto Electric Light Company to Sir William MacKenzie.. 894
New-Type Arc Lamps for Chicago Street Lighting..... 894
Commonwealth Edison Branch, N. E. L. A..... 895
Peculiar Fire at St. Croix Water-Power Plant..... 895
N. E. L. A. Conference..... 895
Congress of Technology at Boston..... 897
Electric Vehicle Conference at Boston..... 899
Single-Phase Railway Electrification..... 899
Basis of Graded Charges for Energy..... 901
New York Meeting of the American Electrochemical Society..... 901
Specifications for New Electrical Code Rubber-Covered Wire..... 904
Decisions on Price Agreements by the United States Supreme Court. 906
Commission News 907
American Electrical Engineers—E. N. Lake..... 910
Current News and Notes 911
Water-Power Development in Southern Minnesota..... 913
A Mechanical Alternating-Current Wave Analyzer. By C. A. Pierce. 916
Pressure Rises on Operating Short-Circuits..... 919
Electric Field Searchlanterns of the United States Army..... 922
Simplified Wireless Telephony. By M. Freimark..... 923
Gasoline Versus Electric Lighting 923
Advertising Central-Station Service by Electric Signs..... 924
Steam Consumption Test of a Small Central Station..... 925
Tungsten Post Lighting with Prismatic Reflectors at Cincinnati..... 926
Illumination of the Cathedral of St. John the Divine, New York.... 927
Recent Telephone Patents..... 930
Letters to the Editor:
Strength of Poles. By Mayo Dyer Hersey..... 930
Regenerative Control. By T. J. Johnston..... 931
Digest of Current Electrical Literature..... 931
Book Reviews..... 935
New Apparatus and Appliances..... 935
Industrial and Commercial News..... 938
General News..... 942
Weekly Record of Electrical Patents..... 949

BRISK FEBRUARY EXPORT TRADE.

It is difficult to tell whether business is dull or not. Some people say it is—and then other people come along with reports of rush and activity. The probability is that all business just now is being conducted on a sane rather than a sanguine basis; and on the whole there can be no objection to that. In the meantime the export trade in electrical goods is certainly brisker than ever, and domestic dullness may in part account for it. The returns for February, 1911, are in excellent contrast with those of last year. The export of electrical instruments and small apparatus for the month has jumped from $607,359 to $939,714. Of heavy electrical machinery the export has risen from $331,136 to $551,885; so that the total amounts under both heads are $938,495 and $1,491,599. The increase is therefore no less than $553,104, which for a short month may well be characterized as extraordinary. Canada remains one of our best of customers, while Brazil is buying heavily and Japan seems inclined to become a large and steady customer as of old. European demand has become almost negligible, which is perhaps unfortunate, but we return the compliment.

CONSTRUCTIVE WORK IN CONSERVATION.

The conference held in New York last week on the governmental control of water-powers, under the auspices of the Power Transmission Section of the National Electric Light Association, was an altogether interesting and useful function. The attendance was very good as to size and remarkably diversified as to representation. The papers and speeches were of unusually high caliber, and an industry affected most seriously by the paralysis inflicted on hydroelectric development by the agitation of the last few years was at last able to voice its well-founded complaints. That these complaints were justified was shown at once by the frank admission of Mr. Fisher, the new Secretary of the Interior, that the national government has no plan or policy as to conservation and the use of water-powers. It is living from hand to mouth, so to speak, by continuing the present status, which is one of "negation." That makes at least a good starting point for some new and definite policy on which all can get together for the welfare of the nation, so that real conservation can be put into force in the utilization of the millions of horse-power now running idly to shameful waste. The Secretary made, it is evident, a most favorable impression on an audience not wholly disposed at first, perhaps, to be friendly, and his visit to New York must be accepted as an event of the best augury. He must have felt that he was met with a frankness and openness of mind equal to his own. It is, indeed, not a little curious to see, as evidenced by the discussion, that among the engineers and capitalists themselves, as amongst the larger public, differences of opinion exist as to how to go about it, what is best, and where real control of the powers lies and should vest. There must be some definite and general agreement before any forward work can be accomplished, and the conference seems to have helped most materially in that direction.

One of the features of water-power development upon which much emphasis was placed was the question of tenure. There are well-defined disadvantages in limited tenure without provision for extension of time, and there are possibilities of abuse in perpetual rights without regulation of service and rates. However, the disadvantages decrease when extension of time of occupation is made dependent upon service rendered, and the abuse involved in perpetual occupancy is eliminated when regulation is made effective. Whatever may be the form of tenure adopted it seems safe to predict regulation by commission, in which event the attractiveness of the development proposition to financiers is maintained and good service to the public is assured. In the development of water-powers upon public domain for utilization for public service the public-service companies are entitled to protection of their rights and adequate returns upon the money expended, and the public is entitled to proper service at reasonable charges therefor. It is to the interest of both the public and the companies that all unnecessary restrictions upon water-power developments be removed. With the unnecessary restrictions removed the division of benefits between the public as consumers and the companies as investors can well be determined by properly selected public-utility commissions. The temperately worded resolution unanimously passed by the conference should result in the accumulation of the information needed by such commissions in determining the regulation to which water-power companies should be subjected.

NEW RUBBER-COVERED-WIRE SPECIFICATIONS.

Rubber-covered wire labeled "National Electrical Code Standard" may be good, bad or indifferent. The label signifies merely that the wire has met certain tests and requirements, and, strange to say, wire with no rubber at all in the insulating compound has been known to pass muster. An insulation resistance of 100 megohms per mile during thirty days' immersion in water at 70 deg. Fahr. was the criterion and manufacturers had no difficulty in compounding a mixture that would show an initial resistance twenty times as high and yet be good for noting a year later. The cheapest wire that would pass the rules was what was wanted by electrical contractors who had to meet competition, and they would always find some manufacturer who was willing to accommodate them. Happily, some years ago the underwriters saw a light and set about to remedy a condition fast becoming intolerable. Meanwhile, however, private interests would no longer accept code wire and numerous municipalities passed ordinances virtually shutting it out from their borders. Now come the underwriters with more rigid specifications which it would seem impossible for manufacturers to get around if they would. Knowing from experience that an electrical test in itself did not suffice and appreciating that it was possible to beat even a physical and a chemical test separately, they have drawn up a combination of tests which baffles evasion. The specifications are printed elsewhere in this issue.

The underwriters have not sought the very best that can be obtained, but a wire that it is safe to use. The standard is not raised above what it was years ago, and the cost of the wire need not be increased greatly because of the new order. If the underwriters had specified 30 per cent of fine new Para rubber as a minimum, the industry might well stand aghast at the prospect with rubber at $1.40 a pound as it is at present. Assurance is given by the Rubber-Covered Wire Engineers' Association that under the new specifications the cost will be increased about 15 per cent for No. 14 wire and less for the larger sizes, and, inasmuch as the cost of the wire represents at most only about 20 per cent of the price of a wiring installation in first-class cities, no undue hardships will result. The manufacturers of rubber-covered wire welcome the change, as it will enable many of them whose integrity would not permit them to lower their standards to compete on an equitable basis for a share of this immense trade. Much better wire is made by most of them, but the cost ranges from 50 per cent to 100 per cent higher than that of the code wire, and from a fire-hazard viewpoint such wire is better than necessary. A glance at the new code specifications will show them to be a vast improvement not only over the present code requirements but over those recently adopted by some cities that have given this matter attention. Although the specifications will not become effective until probably a year from now, new code wire will probably be on the market in about six months.

OVERVOLTAGES ON OPENING SHORT-CIRCUITS.

When a direct-current generator supplies energy to a constant-potential system of mains and a short-circuit suddenly occurs on the system it is the duty of the nearest circuit-breaker to cut off the short-circuited branch from the system and relieve the healthy remainder of the tree from the overload. If, for instance, the short-circuit occurs in a particular motor, the circuit-breaker adjacent to the motor, and ordinarily mounted on the motor starting-panel, is supposed to open automatically. If it should fail, then the circuit-breaking device at the floor panel or at the service entrance to the building should open. The ordinary short-circuit is thus dealt with automatically without any difficulty or concern. The violence of a short-circuit depends upon its magnitude and suddenness. A short-circuit at a house service box is usually more violent than at a remote outlet on the fifth floor. A violent short-circuit may happen to do damage in particular cases, either by mechanically straining the generator unit, by overheating the conducting path, or by generating a sudden overvoltage on the system at the moment of opening the short-circuit. Such overvoltages may cause the insulation of the system to break down at some other point.

On page 919 is printed an abstract of a very practical paper dealing with an experimental inquiry into the behavior of circuit-breakers as used in Great Britain. The oscillographs appended show that when the short-circuit was made on mains receiving energy from a shunt generator the overvoltage produced tended to be greater than when a storage battery was used, owing to the greater inductance of the generator. While this appears to be a fair deduction for the particular circuit investigated, it would be unsafe to generalize from this case and to assume that overvoltages are always more pronounced with generator supply than with storage-battery supply, because when a powerful storage battery is used it may build up current through the short-circuit so much more rapidly than a generator that when the rupture comes the effect of the greater current in the one case may outweigh the effect of the greater self-induction in the other. Again, the oscillograms show how much the overvoltage depends on the suddenness of the rupture. The oil-break behaved distinctly better than the air-break equip-

ment. The relatively lower overvoltages with storage-battery supply are partly attributable to the limited current of the battery, which did not exceed 1200 amp. Here again, however, the advantages of the oil-break are disclosed in the curves. On alternating-current circuits the oil-break has the additional advantage referred to in the article that the oil chills the arc out of existence at the first zero passage of the current. An air-break is not nearly so effective in this respect, and the arc is apt to carry over into the next reversal.

PORTABLE SEARCHLANTERNS.

A brief article elsewhere in our columns gives a vivid idea of the ingenious way in which technical engineering reinforces the army in its field operations. No sooner is an advance made in science than the military engineers seize upon it and adapt it to their uses. Of late there have been most ingenious modifications of motor trucks devised for army use in almost every possible sphere of its activity. The present paper gives a brief description of the portable and effective searchlantern apparatus which has been developed recently by the engineer corps. The searchlantern in offensive and defensive military operations has many times demonstrated its usefulness. More than a century since the importance of lighting the enemy's works was recognized and the necessity met by the production of fireballs thrown from mortars and loaded with a small shell to discourage efforts at their extinguishment. With the invention of the oxyhydrogen blowpipe a powerful source of artificial light readily adapted for use with projecting mirrors was at hand, and at least as early as the autumn of 1863 the oxyhydrogen searchlantern found its way into military practice. It was used at that time in the siege of Charleston, in the trenches before Fort Wagner, and subsequently in the batteries directed against Fort Sumter, in the latter case at a distance of some three-quarters of a mile. But the active use of the searchlantern had to wait for the development of the electric arc lamp, because readily portable electric plants were not conveniently available until the evolution of the gasoline engine which has resulted from the automobile industry.

The present equipment is interesting on account of the unusual character of the drive. The generating set of 15-kw rating is operated by a five-cylinder gasoline engine directly coupled to an 85-volt interpole generator. This serves to operate the searchlantern when in use. When in transit the energy is supplied by the generator to four motors, one within each steel-plate wheel, which it drives through an interior gear. The searchlantern itself is carried on a field artillery caisson towed in the usual manner behind the truck, and is of the 30-in. size with remote control. A further adjunct to the equipment is a telescoping tower for mounting the searchlantern in the field. This enables the lamp to be carried 30 ft. above the ground if necessary and to be operated at this height by distant control, so that the lantern itself can be used without exposing the operators to machine-gun fire, by which the lantern itself with its metallic mirror is not easily put out of action. The wireless telegraph, the portable searchlantern and the aeroplane are three developments of applied science likely to play no unimportant part in the next war, and it is a matter of some satisfaction to realize that the United States Army, small though it is numerically, is not backward in the development of these technical auxiliaries.

MECHANICAL ALTERNATING-CURRENT WAVE ANALYZER.

No great progress can be made in the study of alternating-current phenomena without means for analyzing a complex alternating current into its harmonic components. The elementary theory of alternating currents is ideal in the sense that it contemplates all such currents as simply sinusoidal in wave-form, just as the elementary theory of geodetics or of navigation contemplates a simply spherical world. But unless we are content with first approximations a simply spherical world does not conform with geodetic measurements and a simple sinusoidal current-wave theory often leads to marked inaccuracies in reasonings concerning alternating currents. The determination of the harmonic components in an alternating-current wave may be effected either by computation from a step-by-step ondographic measurement or by a process of computation based upon the co-ordinates of the photographed wave-form, or it may be arrived at electrically by an experimental weeding out process.

The article by Dr. C. A. Pierce which we publish this week offers another means of arriving at the analysis. It may be described as an experimental means of executing the "strip" method, which ordinarily has to be executed by graphical computation. It employs a set of commutators, one for each harmonic component, and all are rotated on the same shaft in synchronism with the e.m.f. to be analyzed. A direct-current voltmeter is connected to the brushes of each commutator in turn and the maximum reading is obtained by trial on adjusting the diameter of commutation. A brief computation from the observed rectified readings and the reading of an alternating-current voltmeter across the mains then gives the respective values of the harmonic components. The new method has the advantage of being nearly direct reading and of being swift in application. No oscillogram or curve of wave-form has to be obtained. Moreover, if the wave-form of the e.m.f. or current under consideration is subject to change, the amount of this change in any one component can be very speedily found as it occurs by merely seeking the maximum direct-current voltmeter reading and the diameter of rectification on the commutator at which it is obtained.

Until experience has been obtained with an apparatus of this character it is difficult to arrive at an estimate of its practical value. It would seem, however, that a difficulty with the apparatus might lie in maintaining its adjustment. Each commutator has to run smoothly at a high speed and a pair of brushes must be maintained in smooth contact therewith. The brushes must lie as closely as possible upon a diameter, must neither miss contacts nor bridge contacts. A harmonic analyzer is an instrument that is apt to lie idle for considerable periods between times of use, and the effort required to restore the instrument to working order after a long period of use should not be great if it is to remain in practical favor. It remains to be seen how far such criticisms may apply in practice. There is certainly a need for an experimental harmonic analyzer, and the design of this one is very interesting, whatever its practical capabilities may be. At present dependence must be placed upon the mathematical analysis of oscillographic records of alternating-current waves. In the first place, such records are not reliable if the oscillograph is not in proper damping adjustment. In the next place, as pointed out in the article, the outline of the oscillographic record is seldom sharp enough to admit of a high degree of precision in analysis.

Central-Station Statistics.

The April issue of *The McGraw Electrical Directory* contains reports of 169 companies not previously listed. The total number of companies is 6239, as against 6180 reported in the October, 1910, issue—the net increase being 59. The difference is due to the large number of small plants which have been taken over by large corporations, and does not mean fewer electric plants, but fewer electric companies. The total number of companies in the United States is 5718, as against 5669 in the October issue, with 153 new companies added. There are 3689 companies carrying supplies, an increase of 111. The total number of municipal plants is 1494, 1352 of this number being in the United States. The number of companies using only direct current is 903, being 13 less than previously reported, while the companies using only alternating current is 3935, an increase of 175. Two hundred and fifty-eight companies report the use of steam for heating and 1267 companies operate hydroelectric plants wholly or in part, the largest number being in New York, which gives 136, followed by Michigan with 82, Wisconsin, 71; Maine, 54, and California, 48. Fuller reports have been secured regarding the companies also manufacturing ice, which brings the number up to 218, as against 105 in the October issue. The list of electrical dealers and contractors contains 6084 names.

Technical Students at Foreign Schools.

The following compilation giving the number of students attending the engineering courses of seven of the large German technical high schools and of one Swedish technical school during the term 1910-1911 is reprinted from *Teknisk Tidskrift* (Sweden). It will be seen that the grand total of students enrolled at the seven German schools is over 10,000, of which 1492 are enrolled in courses of electrical engineering and 576 in courses combining electrical and mechanical engineering. In five schools reporting the number of foreigners enrolled these latter form no less than 26 per cent of the students.

	Electrical Engineering.	Mechanical Engineering.	Chemical and Metallurgical Engineering.	Architecture	Civil.	Special.	Total.	German.	Foreigners.
Berlin	162	758	211	432	638	397	2598	....	....
Braunschweig	95*	95*	167	64	119	61	506	451	55
Darmstadt	345	166	163	331	271	46	1322	957	365
Dresden	481*	481*	227	229*	229*	106	1043	812	231
Karlsruhe	278	178	230	202	208	39	1135	....	....
Munich	576	206	304	534	534	602	2756	2106	650
Stuttgart	131	22	94	187	186	91	711	674	37
Total	2068	1906	1396	1979	2185	1342	10,071	5000	1338
Stockholm, Sweden	68	85	93	32	104	59	441	....	....

*Courses combined.

Sale of Toronto Electric Light Company to Sir William MacKenzie.

At a meeting of the board of directors of the Toronto Electric Light Company at Toronto on April 8 the offer of the corporation of the City of Toronto to pay $125 per share for the plant and equipment of the company, the shareholders to keep possession of the liquid assets or accounts receivable, was rejected. The board decided to recommend to the shareholders for acceptance an offer made on behalf of Sir William MacKenzie, president of the Toronto Railway Company, to purchase the stock of the Toronto Electric Light Company for the sum of $135 cash per share, on payment of $20 per share now and the balance within six months. Under this accepted offer the shareholders on depositing their scrip with National Trust Company will receive $20 per share cash and new scrip for the remaining $115 per share bearing interest at the rate of 6 per cent per annum. Within three months the new scrip will be redeemed by a cash payment, completing the deal, and the control of the company will be transferred to a syndicate headed by Sir William MacKenzie. To carry out the proposed transfer two-thirds of the shareholders must agree, but as the directors already control the company the deal will go through as a matter of certainty. In the meantime the business of the Toronto Electric Light Company will be carried on as usual, the old directors being re-elected and retaining their positions until the purchasing interests assume control.

The result of this purchase will give Sir William MacKenzie control of practically the entire electric service and railway business within the Toronto district, as he already has control of the Toronto Railway Company, which company, through the ownership of stock, controls the Toronto and Radial Railway and the Electrical Development Company of Ontario. The latter company owns the generating station at Niagara Falls, Ont., and owns the Toronto & Niagara Power Company, which constructed and operates the transmission line from the Falls to Toronto, while the Toronto Electric Light Company distributes the Niagara energy through its long-term contract with the Electrical Development Company.

It is expected now that all the public-utility companies are under one control that an active campaign of opposition will be waged in Toronto between these interests and the Hydro-electric Commission and the corporation of Toronto for the electricity supply business of the district.

New-Type Arc Lamps for Chicago Street Lighting.

As previously announced in these columns, electric street lighting is to be extended in the City of Chicago by the addition of about 10,000 arc lamps to the 12,000 already installed. The City of Chicago has made a contract with the trustees of the Sanitary District, who control the Drainage Canal output, which will make it possible for the city to obtain energy for these additional lamps.

Although the exact specifications for the additional new lamps which are to be installed have not been drawn up, it seems now practically certain that the lamps specified will be of a new type. The lamp under consideration is of the series alternating-current 60-cycle flame-arc type, taking not over 60 volts at the lamp terminals at 10 amp. The arc will be inclosed and the minimum hours of burning with one trim will probably be specified as 100. Eight thousand lamps will be taken on the first order, which will later be increased by 2000 lamps.

Sample lamps of this type are being tried out in a small way on some of the street corners in Chicago. They may be classed as occupying a position between the common flaming arc, which has a short life of electrode, and the old inclosed carbon-arc lamp. It is to be presumed that the efficiency of the lamp will likewise fall somewhere between the present flame arc and the old-fashioned inclosed-carbon arc. At any rate, the lamps

when operated at the 10 amp specified will probably be the most powerful illuminant used for regular street lighting on a large scale in the United States.

Commonwealth Edison Branch, N. E. L. A.

At the meeting of the Commonwealth Edison Branch of the National Electric Light Association at Handel Hall, Chicago, on the evening of April 6, there was an attendance of 380. Chairman Ernest F. Smith announced that the total membership of the branch was 930, an increase of 90 per cent since Nov. 1, 1910. The new badges were distributed. The central portion of the badge is the bronze emblem of the parent association, while surrounding it are the words "Commonwealth Edison Branch, Chicago," on a circle having segments of red, white and blue enamel. It was voted to present gold badges to the chairman and past-chairmen.

Three papers were read at the meeting. The first was by Mr. H. A. Seymour, of the advertising department of the company and editor of the *Electric City Magazine*, who described the methods and aims of that monthly publication under the title "An Educative Force in the Electric Service Field." Mr. Harold Wright, of the contract department, read a paper on "Methods of Handling Business to Give Service," in which he told of the elaborate system of procedure of the contract department, with its numerous blanks and forms in the matter of handling reports, orders and contracts relating to new business. The third paper was by Mr. A. P. Good, of the engineering department, whose subject was "Interior Wiring Inspection." He told of the work of the inspection division of the engineering department in passing on the wiring on customers' premises. All of the papers were illustrated by lantern-slide pictures. Mr. G. L. Knight, of the Edison Electric Illuminating Company of Brooklyn, was a visitor and made a few remarks. He mentioned the fact that the Brooklyn Branch of the N. E. L. A. has now 520 members. The percentage of attendance at the meetings of this branch is very high, there being 490 members present at a recent meeting.

Following the serious part of the program there was an entertainment consisting of instrumental and vocal music, impersonations, amusing cartoons and a "chalk talk," all of the performers being employees of the company.

Peculiar Fire at St. Croix Water-Power Plant.

A peculiar accident due to a generator burn-out on April 3 in the Apple River Falls water-power plant of the St. Croix Power Company, near Somerset, Wis., set fire to the building, causing $5,000 damage, and resulted in several days' interruption to the operation of the station. The output of this plant is transmitted twenty-five miles into St. Paul, Minn., where it is utilized by the St. Paul Gas Light Company in conjunction with its local steam plant for supplying service to its St. Paul electric customers.

Breakdown of one of the 750-kw generators in the water-power plant caused the machine to burn out. Flying pieces of its armature coils set fire to the roof in a number of places, and a section about 30 ft. square was burned off. In the efforts to extinguish this fire water was thrown and some of the remaining equipment was soaked. Except for the water-soaked condition of this apparatus the plant might have continued in operation. It was, of course, immediately shut down and the machines carefully dried out so that several days later operation was resumed.

The total loss occasioned by the burn-out and fire will probably not exceed $5,000. Newspaper accounts the day of the accident greatly exaggerated the damage and its effect on the company's service at St. Paul. The local steam plant and storage battery were able to carry the load without interruption and with equipment to spare, so that no effects of the accident were felt at St. Paul.

N. E. L. A. Conservation Conference.

At the public conference on water-powers and their governmental control held under the auspices of the transmission section of the National Electric Light Association, in New York, on April 8, the feature of highest importance was the presence of Secretary of the Interior Fisher, who listened with sympathetic interest to the arguments of the various speakers and explained the attitude of the present administration concerning the development of water-power.

In his opening remarks Mr. H. L. Doherty, as chairman of the transmission section of the N. E. L. A., called attention to the fact that this organization represents over 80 per cent of the money invested in the electricity supply business in this country, the amount being in excess of $2,000,000,000, and showed that the discussion of the attitude of the national and state governments toward the development and utilization of water-powers is well within its province. He presented statistics indicating that approximately 33,500,000 hp in water, which can be economically developed, is not yet utilized, while the country is using annually more than $200,000,000 in fuel that might be saved by the development of the water-powers.

The development of water-power has been retarded by obstacles placed by the government which are of no benefit to the government or to the people. Although the N. E. L. A. is the only national body representing the financial and commercial, as well as the technical, side of the electricity supply business, it was not called upon when the government policy as to water-powers was framed. The association, therefore, inaugurated the conference as a public meeting, where all might be heard with proper regard to the opposing opinions of others, in order to determine what should be the attitude of the national and state governments toward water-power developments.

The chief paper of the session was one by Mr. Sidney Z. Mitchell, of the Electric Bond & Share Company, New York. Mr. Mitchell spoke of the fact that since water is not altered by its use for producing power, while the power thus produced results in the saving of fuel, the only real method of conservation represents the utilization of the water for power purposes. He stated that true conservation of this character is not now being practised as widely as should be the case. He attributed the lack of development to the obstacles placed by present governmental regulations upon water-power utilization. Attention was called to the fact that the use of water-power for public-utility purposes is essentially different from its use for private purposes. In the one case the benefits derived are shared by the whole public, while in the other case all of the profits go to private owners. The proper attitude for the government to take is one which will encourage the fullest utilization of the water-powers, with proper regulation of the service for the public benefit. Among the great obstacles placed by the government upon water-power development mention was made of large taxes, limited franchises and restrictions relating to dams on so-called navigable streams. He claimed that limited franchises placed upon water-power result in the equivalent of limited tenure upon not only the hydraulic development but also upon the whole electrical equipment, including transmission line, substation and distributing circuits. He said that if the government insists on limited tenure and the expectation is that the tenure will be renewed on equitable terms, the government should give some assurance to the investors in order to facilitate the financing of the development. Any disadvantage of this nature under which the company is placed must result in excess charges to the public for service.

Secretary Fisher expressed his appreciation of the value of the conference as a means of obtaining information concerning the attitude of the public-service companies upon the development of water-powers. He expressed the belief that there is not at the present time any conflict between the state and the federal control over the water-powers. If, however, such conflict does exist, it should be pointed out and will then be remedied. He claimed that there is at the present time no set governmental policy concerning the development of water-

powers. The government is postponing the forming of any policy until it has obtained the requisite information concerning the subject. Such information can best be obtained from societies such as the National Electric Light Association.

In a written communication Mr. Calvert Townley, vice-president of the Connecticut Company, New Haven, Conn., stated that the attitude of the government seems to be neither constructive nor obstructive, but rather meddling. This attitude is especially noticeable in the New England States, where, although there are at the present time no government reservations, yet much water-power remains undeveloped. All of the water-power developments already made have not proved satisfactory commercially. They are not the equal of gold mines, as the public has been led to believe. The imposition of high taxes upon water-powers is not desirable. It retards development and merely increases the cost to the consumer of the energy produced.

Mr. J. R. McKee, of New York, stated that the discussions should be confined to detailed information relating to water-power development, instead of generalities indulged in for mere eloquence. He called attention to the fact that the amount of land withdrawn for entry in the United States proper represents an area forty-four times as large as the State of Massachusetts. He stated that the salary of persons connected with the Forestry Service is approximately $144,000,000 per year, and yet the reforestation amounts to only 15,000 acres of land. It would seem, therefore, that the Forestry Service is a rather expensive luxury when one considers the results obtained. As a source of income from the forest reservations it is best to look to water-powers. At the present time the development of water-powers on government reservations is much hampered by the necessity for obtaining permission from proper government officials. For example, in certain cases it is essential to obtain permission not only from the Secretary of the Interior, but also from the Secretary of Agriculture and from the Secretary of War. He expressed the opinion that water-powers should be rendered readily available for development, and should be placed under regulation by local authorities, such as public-service commissions.

Mr. Richard Lamb, of New York, called attention to the fact that in many cases the government considers navigation of paramount importance on streams where the water-power, if developed, would be immeasurably more important than the navigation. At the present time the government often expends immense sums to maintain navigation along streams when the commodities transported by water along the routes would pay almost no interest on the money thus expended.

Mr. J. G. White, of New York, stated that the time had definitely arrived when it is essential for a conference to be held between engineers, financiers and government officials, in order to facilitate the development of water-powers. Such development is true conservation. Only by utilizing all the water-powers can the fuel supply of the country be conserved. Although in theory a revocable water-power permit may be disadvantageous, the facts are that the government has not used its power to revoke a permit when money was invested in a development in good faith.

Mr. H. E. Cutler, of Boston, stated that the problems of formulating laws relating to water-power development are greatly involved, and suggested that a commission be created to advise with government officials as to the laws that should be made.

Mr. F. E. Frothingham, of Boston, said that the hostility between the public-service corporations and the people is due largely to the ignorance of the general public. What is wanted at the present time is widespread knowledge concerning the problems encountered by such corporations. The National Electric Light Association should make of itself a source of information, both for the government and for the public. He stated that terminable tenure is of no benefit to anyone. It renders difficult the obtaining of money by the developing company, and causes such a company to increase its charges for service to the consumer. The company is placed at a disadvantage, the consumer is also placed at a disadvantage, while the government obtains no advantage whatsoever.

Mr. John Bogart, consulting engineer, New York, called the attention of the conference to the peculiar conditions existing on the so-called navigable stream, the Tennessee River, near Chattanooga, Tenn. During the dry season the river cannot be navigated on account of low water, while during the wet season the vessels cannot proceed on account of floods. The government issued a permit for the construction by a private company of a dam, work upon which was begun in 1905. This dam was intended primarily for water-power development, but it has proved highly advantageous in maintaining navigation throughout the whole year. The permit is for ninety-nine years, at the expiration of which time the property is to be given over to the government without cost. The dam, which is located thirteen miles below Chattanooga in a direct line and thirty-three miles by the river, will permit of about 50,000 hp being developed.

Mr. J. H. Finney, of Washington, remarked that the conservation idea is not a fad. It has come to stay and should be embraced rather than opposed. As applied to water-powers it means use rather than non-use. However, it must be appreciated that in the final analysis all public utilities are public property, and should be thus considered by all parties concerned. The operating companies should be permitted to obtain a proper income and the public should have proper service, which can be accomplished only when the government maintains the correct attitude concerning the companies.

Mr. C. F. Scott, of Pittsburgh, explained that the present recognition of the possibilities of water-power development is due to the work of the engineer during relatively recent years. The laws which now hamper the development of water-powers were formulated before such work had been accomplished. The old lawmakers could not possibly have predicted present conditions, and it will be seen, therefore, that laws have not kept pace with developments. He stated that the laws already made for railways are largely applicable to water-power. He suggested that the government adopt some constructive policy in order to make water-powers available to the public at equitable rates.

Mr. R. D. Mershon, of New York, outlined the problems relating to water-power development which remain to be solved. Among these are the placing of restrictions by either the state or the federal government and the holding of the title by the company or by the people. If the title is held by the people it is yet to be determined in what way the people can transfer the title to a company. He expressed the opinion that the control can better be placed with the state than with the federal government and the title should remain with the people. In order for development to take place it is necessary for the proposition to be made attractive to capital. He stated that a limited tenure is quite as permissible with the water-power proposition as it is with a public-utility franchise. In fact, water-power rights should be considered on a par with a public-utility franchise.

Mr. H. L. Doherty, of New York, expressed his disagreement with Mr. Mershon concerning the permissibility of limited tenure. It creates an artificial amortization rate. It is far better to have an unlimited franchise with public-utility commission regulation. Mr. S. Z. Mitchell reiterated his claim that a franchise for water-power development should be perpetual. When such a plan is put in operation all parties concerned gain thereby, while no one loses.

Mr. F. J. Sprague, of New York, stated that when franchises are given for a limited term the consumers must necessarily be charged at an extra rate during the life of the franchise, after which there will either be a drop in the rate or an increase in the income, neither of which is desirable. He claimed also that the problem is much complicated by reason of the necessity for increasing the equipment during the life of the franchise. The operating company is compelled to increase its equipment in order to keep pace with the demand for service, and it would be unwilling to expend money for such increased equipment as

the time approached at which the franchise would terminate.

Mr. P. H. Thomas, of New York, remarked that many different methods are available by which the public can obtain the results desired. However, in selecting a method consideration should be given not only to the public, but also to the company. Doubtless in the end a compromise method will be found best.

Mr. D. B. Rushmore, of Schenectady, said that the co-operative spirit shown by the conference is highly encouraging with reference to the prospects for increased water-power development. What is needed at the present time is detailed information, in order that the conclusions derived may be in conformity with the existing facts.

Secretary of the Interior Fisher remarked that when all the facts become known the conflict between state and federal and that between public and private interests will disappear, since the interests are, in fact, identical. He said that the conference has proved excellent in affording opportunity for the interchange of information.

A committee consisting of Messrs. S. Z. Mitchell, R. D. Mershon, C. F. Scott, P. G. Gossler, M. A. Viele and C. F. Wallace was appointed to formulate resolutions expressing the general opinion of the conference. This committee reported as follows:

"*Resolved,* That it is the sense of this meeting, convened at the instance of the power transmission section of the national body, that the National Electric Light Association should offer its co-operation with the legislative and executive branches of the national and state governments for the formulation of a definite, constructive policy which will encourage the prompt and fullest development of our water-powers in the public interests; and be it further

"*Resolved,* That to this end it is recommended that the officers of the National Electric Light Association appoint a committee or committeees with power to act in the premises, and to invite the co-operation of such engineering, commercial or other bodies as they may deem expedient."

Congress of Technology at Boston.

The fiftieth anniversary of the founding of the Massachusetts Institute of Technology was celebrated at Boston on April 10 and 11 by a Congress of Technology, which was attended by a large number of engineers and scientists prominent in American industrial applications and research. The congress marked in an interesting manner the advanced status which engineering education has attained within the past half century and disclosed in a long list of professional papers read at the sessions the responsibility and standing of the technical graduate in modern affairs. President Maclaurin roused the congress to a high pitch of enthusiasm at the opening session by showing the absolute dependence of the civilized world upon applied science, a condition which postulates thorough undergraduate and graduate professional education and training in order that the demands of modern life shall be efficiently met. The program included many features of interest to specialists, men of large business affairs and the general public in connection with water supply, sewerage, sanitation, industrial and chemical engineering, gas-engine, steam and electrical practice, economics and finance. Abstracts of several papers of interest to electrical workers are given below.

Improvements of Efficiency of Electric Lighting Properties and What the Public Gains Thereby.

The author of this paper, Mr. W. H. Blood, Jr., technical expert, Stone & Webster, Boston, Mass., contrasted early central-station equipment and methods with present practice, expressing numerically typical savings effected by the development of apparatus and scientific management, and emphasizing the reductions in rates and gains to the public which have resulted from improvements in systems of charging and in the design of energy-consuming devices. Twenty-five per cent of the fuel is being saved to-day owing to improvement in the efficiency of the electric generators. This means the conservation of $12,000,000 worth of coal a year. This improvement has been accomplished partly through the increase in the size of generating units from 100 hp to 25,000 hp. Besides being more efficient, the new 25,000-hp generators are much more reliable and little if any more complicated than the older and smaller machines. Individual generator efficiency has risen from 70 per cent to 97 per cent. A 15,000-kw unit occupies less than half the space occupied by a former 3500-kw engine-driven set, which means that the operating company is getting eight times the capacity on the same floor space. An early plant containing twenty 100-hp dynamos required, including boilers and auxiliaries, 4.5 sq. ft. per horse-power. The same company is to-day building a new station which will have an ultimate capacity of 140,000 hp and which will require but slightly in excess of ½ sq. ft. per horse-power. The first plant represented an investment of $225 per horse-power and the second will cost about $45 per horse-power. Had there been no improvement in machinery design an additional investment of $12,500,000 would have been required. Mr. Blood reviewed the benefits of direct connection, the growing economy of steam-turbine units, increasing size of boilers, flexibility of modern switchboards, and labor-saving results of the use of units of great size. Only 30 per cent as much coal is needed to-day per kw-hour as was demanded twenty years ago, which means that if the fuel economy had not been effected a 5000-kw plant now earning 8¾ per cent on the investment would face a deficit of 6 per cent. Accompanying this go reductions from 16 cents to 10 cents per kw-hour in price charged the public. During the past twenty years the rate of return on the money actually invested in central stations has not materially changed, unless to decrease slightly because electrical properties are fast getting out of the speculative class and are, therefore, satisfying their owners with a somewhat reduced return. Continuing, the author discussed the benefits of high-tension alternating-current transmission, the adoption of direct-connected motor drives, utilization of water-powers, improvements in incandescent-lamp design, increase of household conveniences and the benefits of centralized management of public-service properties. He pointed out that the utilization of Niagara power saves about 6,500,000 tons of coal yearly; that scientific administration on the centralized plan has resulted in the introduction of equitable rates for electricity established in proportion to the cost of supplying the consumer, and that from being high-priced luxuries twenty years ago electric lights are to-day inexpensive necessities. Formerly hazardous undertakings have become safe and sure investments as a result of the work of the technical graduates.

Mechanical Handling of Materials.

This topic was discussed by Mr. Richard Devens, New York, and, although mainly of mechanical interest, the paper included the statement that the steamer *Morgan* of the Pittsburgh Steamship Company, with a cargo of 11,319 tons of ore, was recently unloaded at Fairport in five hours and fifty-eight minutes. Six Brown electric unloaders handled the work, and the result of these improved dock methods was that the vessel made a larger number of trips in the season, thereby increasing her earning capacity. The author made an able plea for the reduction of labor by the use of machinery in transferring freight.

Power Plant Betterment.

This topic was discussed in a broad manner by Mr. H. H. Hunt, of the Stone & Webster Management Association, Boston, Mass. Mr. Hunt emphasized the importance of expert examination of power plants of small and medium size with a view toward their operating improvement without elaborate cost. The author pointed out that without the co-operation of the station staff little of permament value can be accomplished, and laid much stress upon the need of executive ability and a sympathetic attitude in the power-plant organization. Unexpected ability is not infrequently brought out in men in station service through the progressive application of betterment work. The paper outlined many sources of inefficiency in active plants, including dirty boilers, leaky tubes, blow-off cocks and valves, poorly maintained dampers and gage glasses, leaks in

boiler settings, worn furnace linings, bridge walls, grates, and incorrect instrumental indications. Fluctuations in boiler pressure and feed-water temperature exert a large effect on station economy. The recording instrument was recommended, and the importance of maintaining a daily station log of complete character emphasized. The writer made a strong plea for the purchase of coal on the basis of calorific power and chemical analysis. Fuel is not seldom lost by the absence of scales upon which the company can check its consignments. Bins in which the coal can be accurately measured at any time are most valuable. The paper urged the weighing and checking of the fuel with the greatest care in its use inside the plant property, and recommended carrying forward maintenance on a date-schedule basis. In conclusion, Mr. Hunt urged managers not to fail to spend a few moments regularly on the station log. If this is not done, economy is almost certain to suffer in the long run.

INCREASING EFFICIENCY OF A LARGE GAS-ENGINE PLANT.

The author of this paper, Mr. John G. Callan, of the Arthur D. Little Laboratory, Boston Mass., reviewed the improvements effected in a producer-gas-electric plant in mill service as a result of a test in connection with the acceptance of the installation. The equipment consisted of four single-tandem, double-acting engines driving 810-kw, three-phase alternators. The fuel used in the producer was lignite of 7600 heat units, and the gas averaged 105 heat units. The demand for the product of the mill was greater than its output, which was limited by the inability of the gas-engine plant to generate all the power required. After tests extending over several weeks the cause of the principal difficulty was found to be an inflow of explosive mixture into the exhaust passages, leading to serious back-firing, reduction in capacity and inefficient use of fuel gas. The conditions were much improved by changing the mixture and the ignition point of the engines, maintaining as complete and non-luminous combustion as possible, minimizing the carbon deposits, keeping the valve chamber cooler and enabling the engines through a changed valve setting to run on a so-called flat-topped indicator card. The latter reduced the temperature of the gas at the moment of release when the explosive mixture mingled with it. The economy of the plant was increased and the output enlarged by about 20 per cent as the direct result of the tests. The investigation showed the importance of avoiding engine designs which embody the use of inlet and exhaust valves in close relation to one another.

THE SPIRIT OF ALCHEMY IN MODERN INDUSTRY.

Under this somewhat unusual title Prof. William H. Walker, of the Massachusetts Institute of Technology, advanced a vigorous plea for publicity in industrial research work. He stated that there is in every laboratory much work which could be published and yet conserve the interests of the corporation. Germany is justly held up before us as a shining example of marvellous industrial progress and prosperity, no small factor in which is the helpful attitude her industrial organizations take toward the publicity of scientific data. There is little good in permitting industrial laboratories to remain the secret chamber of the alchemist. A fuller, freer, more generous publicity would bring large rewards.

RESEARCH AS A FINANCIAL ASSET.

Dr. Willis R. Whitney, director of the research laboratory of the General Electric Company, presented a significant paper upon the financial aspects of research work. He pointed out that our intricate and delicately balanced system of work is becoming continually more complex, but is still covered by the elemental laws of demand and survival. New discoveries in our day are largely mental instead of geographical, and the old battles of conquest have become wars with ignorance, struggles to overcome inefficiencies. The research laboratory is merely an extension of the principle of maximum efficiency and specialization. Where a group of men are co-operating, as distinct from merely operating, their work rises with a higher number than the first power. Dr. Whitney reviewed the results of a typical line of investigations beginning in 1901 with high-resistance electrically conducting rods for the meter department, and showed that until electric furnaces were employed in place of the former porcelain kilns the results were most unsatisfactory. With the electric furnace, temperature measurement and control with accurate records of time elements eliminated the uncertainties which had formerly been almost insurmountable. Proceeding along the above line, electrically heated muffles and, later, carbon-tube furnaces were developed for the production of lightning-arrester rods. Out of the carbon-tube furnace came the graphitized-filament carbon lamp, leading later to research upon the tungsten and other filaments of a refractory character. The company's experience with a metallized graphite led to the production of a special carbon for contact surfaces in railway-signal devices, circuit-breakers and motor brushes. A reasonable estimate of the value of a research laboratory is based on the amount of money earned through its work which otherwise would not have been earned by the company, allowing the laboratory a proper time to get under way. The experience and knowledge accumulated in a general research laboratory is a positive quantity. The annual expenditure of the General Electric laboratory passed the $100,000 mark several years ago. Dr. Whitney pointed out that the value of graphitized-carbon filament lamps sold last year was over $1,000,000. On the assumption that the present rate of lamp consumption is equivalent to about 80,000,000 25-watt tungstens per year, and on the basis of 1¼ watts per candle as against 3.1 of the earlier lamps, with energy at 10 cents per kw-hour, there is a total saving of $240,000,000 a year distributed among producers, consumers and others. About 65,000 magnetite-arc lamps, originally a product of the laboratory, are now in use, at an average total sales price of nearly $2,000,000, and bearing a business of $60,000 per year in electrode renewals. The laboratory's study of the properties of the mercury arc produced the rectifier, about 6000 of which have been sold at a total revenue of over $1,000,000. In the field of insulations and molded material the result of research has caused a saving of $24,000 a year for one piece alone. As far back as 1906 the company was using 30,000 specially drilled and machined soapstone plates annually, which cost $1.10 each. As the result of experiments for substitutes it was found that these pieces could be molded in the proper shape, with holes in place and with increased toughness, at a greatly reduced cost. As a result the price of the purchased material, which came from abroad, was reduced to 60 cents, and later the developments enabled the company to make it for 30 cents—a price which the foreign material could not equal. In closing, Dr. Whitney paid a high tribute to German methods of investigation. He pointed out that America is making a good start in the research field, however, and touched upon several lines of profitable inquiry, notably in connection with improved efficiency of illumination. Transformer iron can also be greatly improved, although the advances of the past decade mean a saving of probably $500 a day in the losses in transformers in use at Boston alone. So long as apparatus fails in service there will probably be the equivalent of research laboratories connected with the electrical industries.

ELECTRIC FURNACE FOR ZINC SMELTING.

The author of this paper, Mr. Francis A. Fitzgerald, consulting engineer, Niagara Falls, N. Y., described a new electric furnace equipped with a resistor built up of corrugated plates of special construction for high-resistance service, including an arrangement of the plates as an interlocking device to secure stability. A representative furnace 16 in. long at the top, 10 in. long at the bottom and 6½ in. wide had two resistor sections of seventy-one plates each. When cold this had a resistance of 0.200 ohm and when running at full output, or 150 kw, and with a furnace temperature of 1400 deg. C., the resistance was 0.0375 ohm. The resistance was due almost entirely to the contact between the plates. Working in an atmosphere of metallic zinc there was no danger of the destruction of the carbon resistor. Regulation is effected by transformer taps in the supply circuit. When the furnace is working at full load of 150 kw

the thermal efficiency at 1250 deg. is 78 per cent and at 1425 deg. 72 per cent. The efficiency is still higher in later models. Furnaces of this general type have been successfully used in the melting of aluminum, copper and brass. The furnace walls are double, with air spaces between. The author criticises the use of the arc in furnace work on account of the difficulties of temperature regulation.

Electric Vehicle Conference at Boston.

Continuing the campaign of electric vehicle progress which was inaugurated at Boston on March 4 by a dinner and meeting at the Hotel Thorndike, a conference was held on April 3 at the same hostelry under the auspices of the Boston Edison company for the purpose of securing closer working relations and co-operation between the central station and the electric vehicle manufacturer, with particular reference to the Greater Boston territory. About forty representatives of the electric vehicle industry, including members of the Boston Edison staff, were present at the meeting, which was preceded by a dinner.

Mr. W. H. Atkins announced that the Boston Edison company will supply free electricity to dealers advertising electric vehicles by electric signs, and also for a large electric sign to be erected for the purpose of advertising in one spot all the local electric vehicle sales agencies.

Prof. Dugald C. Jackson, of the Massachusetts Institute of Technology, outlined the possibilities of electric vehicle research at the institute for the benefit of the industry as a whole. He pointed out that a large prospective development is in sight, and in order to make the most of it information of an impartial and scientific nature is needed along many lines, notably in connection with the best duties of electric trucks, the best methods of replacing horses, the actual expense of horse and electric operation in specific cases, cost of garage operation, best methods of routing vehicles to secure the maximum production upon a given cost. Careful statistics of the cost of garaging will be kept at the recently opened public garage of the Edison company. The relation of tire cost to the quality of roadways is another very important matter. If the public realized how the cost of haulage would go down it would insist on proper pavements. The speaker believed that the electric vehicle can defeat the horse even if the latter is routed according to the best possible methods.

Mr. E. S. Mansfield, in charge of the electric vehicle work of the Boston Edison company, delivered a suggestive address showing the vigor and enterprise with which the company is pushing the electric vehicle campaign in its territory of 550 sq. miles. The public interest has been greatly awakened by the coming forward of the Edison company as a believer in and purchaser of electric vehicles. The company's plans for further publicity include the preparation and distribution of four booklets relating to the electric vehicle. The first is to be sent to all the manufacturers and representatives of electric vehicle production in the country, outlining the campaign of the Edison company on behalf of increased development at Boston. The second booklet will be sent to local agents of vehicle manufacturers in the Boston territory for distribution to the general public. The third booklet, entitled "Social Distinction," will be particularly devoted to the electric pleasure vehicle. The booklet will comprise a symposium of the latest pleasure vehicle equipment, and will be sent to the highest class of prospective patrons. The fourth booklet will be devoted to representative commercial vehicles, and it will be sent to high-class establishments which may be interested in efficient transportation.

Mr. Mansfield touched briefly upon the company's plans for further newspaper publicity. On April 21 and May 10 two extra advertisements will be run in all of the nine Boston dailies, one issue being devoted to pleasure and one to commercial vehicles. Each manufacturer will have the opportunity of displaying one of his most typical machines in the advertisement of the Edison company. In the face of the company's offer of free electricity for electric vehicle advertising, Mr. Mansfield said that no dealer's place need be in darkness. The new public garage of the company has not been established to cut into the business of any existing place of the kind. The company is simply trying to prove to the public that such a garage is a success, and that the electric vehicle meets the most severe demands within its field.

Mr. W. H. Francis, purchasing agent of the Edison company, said that there is a great need for an electric automobile which can be run at a schedule speed of twenty miles per hour, at a maximum speed of certainly thirty miles, and without reducing the mileage per charge below from 75 to 100. Such an equipment would do much to displace the gasoline machine in serving the outer suburban territory, where time is at a premium in passing between distributing and commercial centers.

Mr. L. D. Gibbs, superintendent of advertising, Boston Edison company, emphasized the opportunities for co-operative publicity now before the manufacturers. He also brought out the point that a very low maximum rate per kw-hour does not necessarily mean the largest business expansion in connection with the electric vehicle. Mr. Atkins stated that the company has the whole question of electric vehicle rates under consideration, and that it is planning to supply charging sets in the near future which will cost only $60 compared with the present price of about $250.

Mr. Day Baker, General Vehicle Company, cited the formation of a Boston Section of the Electric Vehicle Association of America as an instance of conditions now prevailing. He reviewed the importance of securing a suitable teaming thoroughfare in the City of Boston, pointing out the co-operative work done before legislative committees in connection with the Boston Chamber of Commerce. He felt that the Electric Vehicle Association will in time take care of the differences in charging prices now found in commercial garages. Among the other speakers were Messrs. Redding, of the Studebaker Automobile Company; Converse D. Marsh, New York; C. L. Morgan, Lansden Company; Col. E. W. M. Bailey, Bailey Company; Messrs. Neal, of the Baker Motor Vehicle Company; Daly, of the Babcock Electric Carriage Company; Eldredge, of the Couple-Gear Wheel Company; Emery, of the Walker Vehicle Company; Mr. Rommelfanger, Boston Electric Garage Company, and Mr. L. R. Wallis, superintendent of the sales department Boston Edison company.

Single-Phase Railway Electrification.

At a meeting of the American Institute of Electrical Engineers held in Toronto on April 8 Mr. W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad, presented a profusely illustrated paper entitled 'Electrification Analyzed and Its Practical Application to Trunk-Line Roads, Inclusive of Freight and Passenger Operation." The author recommended the universal adoption of the single-phase system using 11,000-volt, 25-cycle current for any and every trunk line electrification project, including suburban and terminal sections. He ventured the opinion that there is no trunk-line electrification problem to which there cannot be applied some construction drawing now in the engineering files of the New York, New Haven & Hartford Railroad.

He said that the only possible way that electrification can be made to pay is by electing a system the yearly operating cost of which, inclusive of its maintenance charges, subtracted from the yearly cost of the steam system it replaces leaves a figure which represents a little more than the interest on the capital investment required for the installation of the electrical system. When the board of directors of a railroad company passes favorably upon an appropriation of several millions of dollars to purchase power houses at, say, $1,000,000 apiece, locomotives at $30,000 apiece and line construction at $25,000 or $30,000 a mile for a four-track system, it is not an unfair question for those directors (although they may be interested in eliminating the smoke and dirt incident to the original system

replaced, and be glad to have the assurance of the electrical engineer that the time of switching movement of the railroad's equipment in yards, terminal property and main line has been reduced) to ask for a closer analysis than this, and also to ask for some specific explanation as to the return each year of a fair percentage of some of the dollars spent.

LOCOMOTIVES.

Referring to locomotives, Mr. Murray presented figures showing that, in switching, yard speeds could be greatly increased by the use of an electric locomotive of very much less engine capacity than that used in the steam locomotive. On account of the low average rate of energy required for its operation, a central power station will deliver at far higher efficiency the power necessary to the electric switching engine than that obtained from the individual power plant on the steam switching engine itself.

The electric switching locomotive which will be used in the Harlem River and Oak Point yards is of the quill spring-supported type, and on account of the buffing stress incident to yard switching the framing and attachments for all of the electrical apparatus are very strong and substantial. The four motors have an hourly rating of 150 hp each, giving the locomotive a total rating of 600 hp. This locomotive will be tried out in the electrified Stamford yard.

About a year ago a multiple-unit train consisting of four motor cars and six trailers was put in service. There are now under construction four additional motor cars and twelve trailers. These multiple-unit cars will gradually replace electric locomotives for suburban service, and the locomotives so released will be used in express service between New York and New Haven.

The complication of control apparatus to permit of operation on both alternating-current and direct-current sections is very marked. All freight and switching locomotives will have single-phase control only, as will the multiple-unit cars to be purchased for the Harlem River Branch and the New York, Westchester & Boston. The saving in weight of straight alternating-current control over alternating-current-direct-current control is more than 8000 lb. per car or locomotive.

LOG OF THE NEW HAVEN ELECTRIC OPERATION.

As showing the great improvement in the reliability of electric operation as time had developed troubles and remedies for them, Mr. Murray supplemented his "Log of the New Haven Electrification," presented before the Institute in December, 1908, with figures of train delays for the corresponding six months of 1909. These figures are summarized in the following table:

Month.	Power-House Delays, Minutes.		Line Trouble, Delays. Minutes.		Locomotive Delays, Minutes		Total Delays, Minutes.	
	1908.	1909.	1908.	1909.	1908.	1909.	1908.	1909.
July	0	0	2100	170	1183	153	3283	323
August	132	0	1642	548	407	97	2181	645
September	0	0	942	0	224	219	1166	219
October	0	54	2140	204	343	124	2483	382
November	139	0	103	42	405	95	647	137
December	179	0	194	55	240	315	613	370

The average delay per train in 1909 was 5.25 seconds, as against 27 seconds in 1908. In this connection Mr. Murray said:

"A comparison of the 1909 and 1908 train minute delays is immediately indicative of the fact that even in this short time the disturbing factors of the system had disclosed themselves and had been eliminated. Eighteen months after commercial service was inaugurated our electrical failure report showed a record of over 15,700 miles per engine failure. Between Nov. 2 and 23, 1909, 66,000 electric locomotive miles were run, and this mileage, which is approximately eleven round trips from New York to San Francisco, was accomplished with a total of three minutes' delay. This kind of record is the ground upon which the board of directors of the New Haven road stood in ratifying the system and voting an extension to apply to all service—freight and passenger, inclusive of yards, terminals and main line west of Stamford." He presented diagrams showing that the electric locomotive failures are nine per 100,000 electric locomotive miles, while the steam locomotive failures, which are an average for all of the divisions of the New Haven, are twenty-one.

ENERGY SUPPLY SYSTEM.

The power house of the New York, New Haven & Hartford Railroad at Cos Cob, Conn., which now supplies energy to the main line between Woodlawn and Stamford, will also supply energy for the electrified six-track Harlem River branch and freight yards and the New York, Westchester & Boston, as well as for the operation of direct-current trolley lines connecting White Plains, Mamaroneck, Stamford and Bridgeport. The alternating-current distribution system is a unit without substations and no voltage higher than 11,000 will be used. The wires carrying energy are sectionalized and breakers controlled from the power house are installed to localize any line trouble without affecting the remainder of the network. Briefly described, the control consists of a single wire, upon which is impressed the normal voltage of the system when a short-circuit occurs anywhere, but not until the automatic resistance at the power station has been cut in series with the line, at which moment the control wire, through transformers, passes current through the tripping coils of the sectionalizing breakers, and the two breakers that are directly feeding the short-circuit are immediately opened. The resistance thus inserted, however, has reduced the short-circuiting current to a minimum and relieved greatly the duty of the opening breakers. The resistance scheme above mentioned has proved itself to be a most valuable acquisition to the system, serving at once to lessen the duty on both generating and distributing apparatus.

INSULATION.

Mr. Murray laid special stress on the importance of adequate insulation of lines carrying high-tension current. In this connection he said:

"Practice has shown the wisdom of sectionalizing the lines at cross-overs. At these points it is necessary to bring the electrical catenary cables to a dead end and anchor bridges are supplied for that purpose. Oil switches must be provided for cutting in or out as necessity may require voltage on the lines thus dead-ended. In the order of their higher degree of insulation requirements should be mentioned: One, sectionalizing switches; two, sectionalizing busbars; three, dead-end catenary insulators; four, intermediate catenary insulators." As the whole track system leads into the anchor bridge buses a ground on them means an immediate effect on any wire connected to them. This reasoning is applicable to the switch should the ground be on the busbar side, and as the switch is a piece of moving apparatus it is the more difficult to insulate and to keep insulated, and is, therefore, cited as the one deserving of the highest consideration of insulation. The dead-end insulator has been mentioned third, but it is in a class essentially its own and is worthy of respectful attention. No insulator throughout the past four years has had more constant study. The difference between insulators not under and under mechanical strain while performing at the same time their electrical duty is marked. When the New Haven electrification was completed in 1908 the best dead-end insulator then on the market was one rated at 7000 lb. mechanically and 40,000 volts electrically, and cost $27. In a very short time it was found that two of these had to be used in series, which, with the yoke harness, made the cost $61. To-day orders have been placed for dead-end (or strain) insulators, every one of which is tested before shipment for 110,000 volts under a mechanical strain of 35,000 lb., and they have an ultimate mechanical tensile strength of 50,000 lb. These insulators cost only $7 apiece, as against $61, and are capable of withstanding seven times the mechan-

ical strain and three times the electrical strain of the original insulators.

WEAR OF CONTACT WIRE.

Micrometer measurements of the steel trolley wire showed that the actual vertical wear of the wire since its first installation thirty months ago is 0.028 in., which is practically 4.5 per cent per year of the half diameter of the wire (one-half taken to permit the wire to be held in clips). Even on this vertical-diameter basis this indicates a life of over twenty years. As a matter of fact, it will be much more than this, for the reason that as the vertical diameter lessens the breadth of contact increases throughout, thus diminishing the rate of vertical wear. Of further interest, too, is the fact that there is practically no corrosion on the wire, for, like the traffic rails in service (only much more so), the wire is constantly covered by a film of grease—due to a generous amount of this material being placed on the pantograph shoe.

NEW CONSTRUCTION.

A part of Mr. Murray's paper was devoted to a brief description of the catenary construction in the Hoosac Tunnel. The electrification of the tunnel is now rapidly nearing completion and electric locomotive operation has been begun in the approach yards for the instruction of engineers. The introduction of 11,000 volts into this tunnel, with the close overhead clearance that the double-track arrangement requires, afforded an interesting problem in location and placing of insulators which would insure against any breakdowns between the electrified wires and ground. From the crown of the tunnel is suspended a bracket, on which are installed four insulators, each capable of resisting 150,000 volts to ground. Two of these insulators apply to each track. The arrangement of support is such as to place them in series, thus giving them a combined dielectric strength of 300,000 volts. The outside insulator holds the track messenger wire, from which are hung the contact wires below. Some criticism might be offered against using a 150,000-volt insulator where a 40,000-volt insulator might have sufficed. By the expenditure of $1 more per insulator there was secured practically eight times the insurance from breakdown. The tunnel is five miles long. There are 1000 insulators, hence $1,000 has been spent to secure eight times the protection.

Mr. Murray stated that all of the insulators purchased for the Hoosac Tunnel electrification, inclusive of the tunnel itself and its outside approaches, did not total one-half of 1 per cent of the total expenditure. Insulation is of all things the one most important thing to be right in order to secure continuity of service. It pays a handsome dividend every year.

The two large yards at the terminus of the Harlem River branch contain 62.3 miles of track, all of which will be electrified. On account of the extremely small amount of current required per horse-power developed, and on account of the excellent conductor section offered in the gridiron arrangement of the track yards, not a pound of copper will be required throughout this extensive trackage, with the exception of rail bonds. These are to be reduced to the smallest size and only one rail will be bonded, with the attendant result of an extremely low cost compared to main-line construction. Cross-catenary spans for the support of the track contact wires will be used. By a simple system of bridles, which require only one rigid post to hold many tracks, the overhead contact wires are held in proper alignment over the tracks they serve. The cost of yard electrification, as before stated, varies from $1,500 to $3,000 per mile of track, depending upon the average number of tracks spanned.

Basis of Graded Charges for Energy.

A correspondent of the Chicago *Daily Tribune* recently wrote to that paper for an explanation of the distinction between the "full" or primary rate of 13 cents a kw-hour and the "low" or secondary rate of 7 cents a kw-hour, as made by the Central Station Company. He appeared to have the idea that the difference might explain the cost of wiring the building in which he was a tenant. The newspaper referred the letter to Mr. John F. Gilchrist, assistant to the president of the Commonwealth Edison Company, and his explanation of this distinction, which is so perplexing to the mind of the ordinary customer, may be of general interest.

Mr. Gilchrist wrote: "The distinction between the 'full' rate and the 'low' rate shown on this company's bills for electricity is substantially like a cabman's charge of a certain rate for the first hour or first mile and a lower rate for subsequent miles or hours. The full or maximum rate applies to a use of electricity for not exceeding thirty hours in any month, and the low rate to all additional use of electricity for the month. This is in accordance with the existing city ordinance passed March 23, 1908, regulating the company's maximum rates, and has nothing to do with wiring, but is purely for the consumption of electricity."

New York Meeting of the American Electrochemical Society.

The nineteenth general meeting of the American Electrochemical Society, held in New York City on April 6, 7 and 8, was notably successful in its professional as well as social features and will be remembered with special pleasure as the first convention of a national body held in the new Chemists' Building in New York City. The number of members and guests registered was over 350.

On the three forenoons there were three professional sessions devoted to the reading and discussion of some thirty papers. The first of these sessions was opened by the annual business meeting of the society at which the reports of the secretary and treasurer were presented, showing the society to be in a splendid condition with respect to membership and finances.

The result of the election of officers was as follows: Dr. W. R. Whitney, chief of the Research Laboratory of the General Electric Company, was elected president; Mr. F. A. J. FitzGerald, Dr. E. F. Smith and Mr. Alois von Isakovics, vice-presidents; Dr. E. G. Acheson, Dr. Wilder D. Bancroft and Mr. Carl Hering, managers. Dr. Joseph W. Richards was re-elected secretary and Mr. Pedro G. Salom treasurer.

The program of excursions was very full and included two of the best-equipped copper refineries. The Nichols Copper Company, on Long Island, the largest electrolytic copper refinery in the world, was visited on Thursday afternoon, and the splendid Perth Amboy plant of the American Smelting & Refining Company on Saturday afternoon. For Friday afternoon four optional excursions had been arranged, including a visit to the fine electroplating demonstration plant of the Hanson & Van Winkle Company, in Newark; the electric furnace laboratory of Dr. F. J. Maywald, the New York Testing Laboratories, the photo-engraving and electroplating plant of the Moss Photo-Engraving Company and the laboratories of Columbia University and the College of the City of New York.

A subscription dinner on Thursday night and an informal smoker on Saturday night were very enjoyable, each in its own way. On Friday night there was a joint meeting with the New York Section of the American Electrochemical Society, at which the retiring president, Dr. W. H. Walker, of the Massachusetts Institute of Technology, presented his address on chemical research and industrial progress. The following are abstracts of the papers presented:

ALUNDUM REFRACTORIES.

The first paper was presented by Mr. L. E. Saunders on alundum refractories. Alundum is the trade name of electrically fused bauxite. The process has been carried out for a series of years commercially at Niagara Falls.

The chief application of alundum in the past has been as an abrasive. On account of its heat-resisting properties, however, its applications as a refractory have now been developed. Alundum has a melting point between 2000 deg. C. and 2100 deg. C. The coefficient of linear expansion is very low, about

0.000008. The thermal conductivity is comparatively high, which is an advantage for various applications. It is about twice that of Marquardt porcelain and three or four times that of most fireclays. Alundum articles can be made in various forms, for instance in the form of tubes (pyrometer-protection tubes), muffles, etc. Alundum muffles have four to five times the life of the ordinary clay muffle in gas-furnace work, and are especially adapted to the electrically heated, wire-wound type of laboratory furnace. On account of its porosity filtering dishes can be made from alundum. A useful modification is alundum cement, which may be used to coat the inside of crucibles and furnaces for high-temperature work. Alundum brick has been tested for the roof construction of electrical steel furnaces, where it has shown a very long life.

There was an interesting exhibition of various articles of alundum, and Mr. Saunders' paper was discussed at considerable length by Messrs. Hansen, Beckman, Amberg, Richards and Queneau.

NEW ELECTRIC RESISTANCE FURNACE.

Mr. F. A. J. FitzGerald, of Niagara Falls, then presented a paper on a new resistance furnace originally designed by Mr. John Thomson and himself for carrying out the Imbert electric zinc-smelting process. The furnace is of the radiation type, the heat being radiated from electrically heated resistors placed near the top of the furnace. In order to concentrate the heat radiation as much as possible down onto the charge provision is made to have a greater current density at the lower part of the resistor than at the top. Various arrangements of the resistors were described and the results were given of experiments made with a furnace of this type at the Hohenlohe zinc works in Upper Silesia, Germany.

For certain experiments in which there is an oxidizing atmosphere in the furnace the resistors must be protected and are inclosed in an air-tight resistor compartment with recrystallized silicon-carbide tiles, which have the two required qualities of refractoriness and high heat conductivity. A simple method of producing a reducing atmosphere in the furnace chamber is also described. For the operation of the furnace means must be provided for varying the applied voltage. For this purpose an adjustable transformer with a number of taps or an induction regulator may be employed. The furnace is especially suitable for the melting of copper, brass, aluminum, etc., and possibly of glass.

The paper was discussed by Dr. Whitney and Mr. Carrier.

LABORATORY ELECTRIC FURNACE.

An electric furnace for commercial laboratory work was described in a paper of Mr. M. M. Kohn. Its chief feature is the replaceability of the electric heating units so that when one of these burns out it can be quickly replaced by a new one held in reserve. This was demonstrated during the course of the paper.

The housing of the furnace is built of a number of sections of a special clay. After the sections have been assembled they are placed in a metal case, together with the necessary heat-resisting material and sealed in permanently. In this housing certain peculiarly shaped openings are molded into which the replaceable heating units fit. The latter carry the resistance wire or ribbon made from a special alloy. The furnace is operated directly from 110-volt or 220-volt mains. The safe maximum working temperature is from 1750 deg. Fahr. to 1850 deg. Fahr.

The paper was discussed by Dr. Richards and Dr. Patten.

ELECTRIC FURNACE FOR HEATING BARS AND BILLETS.

A new electric furnace for heating bars and billets was described in a paper by Mr. T. F. Baily, who referred to the very low thermal efficiency of modern oil-fired furnaces for heating forging stock. He has designed for such work an electric furnace of high thermal efficiency. It is a resistance furnace. Two carbon electrodes are provided spaced from each other, with an intermediate resistance body of crushed foundry coke in which the heat is generated. In the space directly under the roof of the furnace is placed the metal to be heated, a ledge at the rear of the furnace and one at the front supporting the bars or billets. The electrodes enter the furnace through the rear wall and are placed slightly convergent, so that the path of the electric current will be shorter from electrode to electrode at the front of the furnace than at the back. This arrangement compensates for the cooling effect from the charging door. Details of the construction of such furnaces were given. The paper was discussed by Messrs. Richards, Hering, Sperry, Lidbury and Hitchcock.

ELECTRIC ZINC SMELTING.

The electric zinc furnace invented by Mr. W. McA. Johnson was the subject of a paper by Dr. Joseph W. Richards, who pointed out the potential advantages of the electric furnace in general for zinc smelting. Mr. Johnson's first large-scale experimental work was directed along lines of treating a charge that produced a dry, fusible residue, but for the last two years he has been engaged in developing an electric furnace to smelt zinc ores with the production of a base lead bullion, a copper matte and a fusible slag. The smelting zone of his zinc furnace is practically a lead furnace, but operated by electrical heat and with slightly more intense reduction conditions, sufficient to reduce the zinc but not to reduce appreciably the amount of the iron oxide in the slag.

The Johnson furnace is in general of the Siemens arc type. In the operation a certain amount of carbon dioxide is evolved which would be fatal to efficient condensation. The gases are, therefore, passed through a filter of hot carbonaceous material, where the percentage of carbon dioxide is reduced to extremely low limits. The slag losses in the furnace are quite low.

The problem of the condensation of zinc vapor from electric furnaces was discussed in a paper by Mr. F. T. Snyder. The author bases his discussion on the design and dimensions of the standard retort zinc condenser and shows how it is possible to derive from these a set of data for use in the design of condensers for zinc vapors from electric furnaces.

RELIABILITY OF ELECTRIC FURNACES.

The last paper of the Thursday session dealt with the reliability of electric furnaces for commercial work, the author being Mr. F. T. Snyder. His conclusions were: (1) That the electric furnace itself has passed from the field of experiment to that of engineering, but that the fields of manufacture using the electric furnace products are still experimental; (2) that the electric furnace is technically reliable and will operate continuously with the men and supplies that are available in this country; that the details are simple and rugged, and that the inherent regulating powers can be made such as to bring it well within the ability of usual plant labor; (3) that the electric furnace is commercially reliable; that when installed with the same business care and adaptation to conditions that should be used with other furnaces it will earn a profit on the investment, and a profit that is larger than the normal manufacturing profit in proportion as the field is newer and more open.

ELECTROMETALLURGY OF GOLD.

The first two papers of the Friday session dealt with the electrometallurgy of gold. Mr. J. F. Clancy discussed the electric cyanamide process for treating gold ore. The object of the process is to find a cheap solvent for gold as a substitute for the expensive cyanide solution now universally employed. The author employs a solution prepared from calcium cyanamide and combines the use of this solution with electrolytic action. The object of the process is simply to dissolve the gold in the solution, but not to deposit it.

A paper by Mr. E. E. Carey dealt with an improvement in the well-known method of recovering gold by amalgamation. In this process the mercury is made the cathode of an electrolytic cell so that the electric current aids the alloying of the gold with the mercury. A suitable "sodium-mercury cell" developed for this purpose is described.

IRON REFINING.

A paper by Prof. C. F. Burgess dealt with electrolytic refining as a step in the production of steel. Since it is possible by

the author's process to refine iron electrolytically as easily as copper, the question is raised as to the usefulness of electrically refined iron, and it is shown that the electrolytic iron may well compete in price with high-grade Swedish iron. Further advantages are its content of hydrogen, which may help in deoxidation, and its brittleness, which makes it easy to break it up into pieces for introduction into steel crucibles.

ELECTROPLATING.

A paper by Prof. W. S. Landis dealt with the corrosion of electroplated objects. The author found that gold-plated steel pens corroded far more rapidly than plain steel pens. This is due to the fact that the friction of the pen point on the paper rapidly wears off the plating on the point, thus exposing the steel; an electrolytic couple consisting of steel, ink and gold is thus set up. The rule is suggested that a material should not be plated with a nobler metal if it is likely to be subjected to wear on one spot and if this spot is liable to be moistened with liquid.

A paper by Mr. George B. Hogaboom emphasized the necessity for more intimate co-operation between the practical electroplater and the electrochemist, and gave a list of unsolved problems in the electroplating art the solution of which would be timely.

POLARIZATION.

A paper by Dr. O. P. Watts on polarization in its relation to the decomposition pressure of electrolytes gave the results of an experimental study of polarization in electrolytic cells set up under different conditions. Polarization is responsible for the phenomenon of decomposition pressure in electrolytes. The total polarization may be resolved into two components, the one at the anode, the other at the cathode. Since it is polarization which prevents the flow of current in accordance with Ohm's law, the residual current is the equivalent in current of the rate of depolarization of the electrodes by the electrolyte.

A paper by Dr. J. H. Mathews described detailed results of a laboratory study on the use of electric heating for preventing superheating of liquids. He described in great detail the most satisfactory arrangements.

STORAGE BATTERY.

A paper was presented by Mr. A. V. Tate on his "bifunctional accumulator." The chemistry is the same as that of the lead cell, the novel features of the new battery being chiefly mechanical. The chief feature is the use of short, narrow conducting strips. The positive and the negative are on both sides of one plate, hence the name "bifunctional." The plates are separated by perforated celluloid strips. Some of the advantages which were discussed in some detail are the avoidance of sulphating and the provision of permanent good contact between active material and support. The specific output of the battery was given as 11 watt-hours to 12 watt-hours per pound of complete battery in service.

ALUMINUM.

A paper by Prof. H. K. Richardson dealt with some observations on the laboratory production of aluminum. For the use of students in the laboratory a mixture of 85 per cent natural cryolite and 15 per cent aluminum is recommended with a current density of 3 amp per square centimeter anode surface. The anode effect appears to be due to two causes, either a gaseous envelope which opens the circuit or a non-wetting of the electrode which causes numerous small arcs. An amp-hour efficiency of 60 per cent to 70 per cent may be obtained.

The paper was discussed at some length by Messrs. Richards, Cowles, Tucker, Walker and Lidbury.

ELECTROLYTIC METER.

A paper by Mr. F. C. Mathers was present on a mercurous perchlorate coulometer. The advantages of mercurous perchlorate solution as an electrolyte for meters and coulometers are summed up as follows:

The ClO radical is exceptionally stable and is absolutely unchanged by electrolysis. Mercurous perchlorate is very soluble in water, and the solutions thus formed are entirely free from any decomposition.

Mercurous perchlorate solutions containing free perchloric acid have very high conductivity, such that a very high current density may be used in electrolysis.

The amount of mercury deposited may be very rapidly determined by measurement rather than by the much slower method of weighing.

The deposited metal is in such form that it may be transferred to the anode for further use without any treatment whatever. Equivalent quantities of electricity deposit from two to six times as great weight of mercury(ous) as of the other metals. This gives greater accuracy.

The paper was discussed by Messrs. Schleuderberg, Hering, and Sharp, especially with reference to the question why electrolytic meters are practically not used in this country.

ELECTRICAL THEORY.

A paper by Prof. L. A. Parsons sketched the phenomena of electrical discharges through gases at reduced pressure and discussed the experimentally established facts with reference to the properties of negative corpuscles and of positive ions in their relation to atoms and molecules.

A paper by Prof. Joseph W. Richards suggested a mechanism of electrolytic transfer based especially on the phenomena of electrolytic conduction through fused salts. One of the chief points is that the electrochemical action at the electrodes is the primary thing and that the electrolytic transfer throughout the electrolyte then follows as a result of the disturbed equilibrium.

PRESIDENTIAL ADDRESS.

The presidential address of the retiring president, Prof. W. H. Walker, was delivered at the evening session of Friday, which was a joint session with the New York Section of the American Chemical Society. It dealt with "chemical research and industrial progress." Dr. Walker condemned strongly the secretiveness of many manufacturers and emphasized forcibly that a free interchange of ideas is most important for further progress of science and industry.

Dr. Harrison E. Patten then lectured on the relation between surface union and electrochemical action.

ELECTROMETALLURGY OF IRON AND STEEL.

The first three papers of the Saturday session were concerned with the electrometallurgy of iron and steel.

A paper by Mr. James Lyman dealt with the application of electric furnaces to the manufacture of iron and steel, and gave descriptions of the following types of furnaces: the Frick electric arc furnace for the reduction of iron ore, the Frick induction furnace for refining steel, the Héroult furnace, and various induction furnaces.

A paper by Mr. C. G. Osborne gave many interesting personal experiences with a 15-ton Héroult electric furnace at the South Chicago works of the United States Steel Corporation, and more details were brought out in the extended discussion which followed. The chief summing up of Mr. Osborne was that while "we are as yet but on the threshold of this method of manufacture, we feel that electric steel is a success and its future assured."

A paper by Mr. A. E. Green discussed the possibilities of the electric steel furnace as a competitor of the Bessemer and open-hearth for making ordinary grades of steel. The author emphasized the great material losses in the Bessemer and open-hearth and showed that if these can be avoided in an electric furnace due to the chemical reactions possible in its adjustable chemical atmosphere there is a prospect for such a process. The author described an electric converter process which has been devised for this object.

ELECTROLYTIC FURNACE FOR METAL PRODUCTION.

A paper by Mr. John Woods Beckman dealt with an electrolytic-furnace method for producing metals, of which were mentioned iron, aluminum, chromium, vanadium, either as metals or alloys. The process is applicable to any metal whose oxide will form a salt with calcium. As applied to iron the process is as follows: Equivalent amounts of Fe_2O_3 and CaO are mixed together and heated in any suitable manner. The salt

$CaOFe_2O_3$ is formed and fused in a receptacle fitted for electrolytic purposes. Oxide of iron is introduced into this fused bath, and this molten solution is electrolyzed, iron being deposited on the cathode and an oxygen development taking place on the anode.

The paper was discussed by Messrs. Hansen, Bleecker, Tucker and Saunders.

A NEW TYPE OF ELECTRIC FURNACE.

In a paper by Mr. Carl Hering a description was given of a new type of electric furnace in which practical use is made of the pinch phenomenon. If a tube (for instance, of alundum) is attached to the bottom of an electric furnace, and this tube is filled with an electric conductor (which is solid at the bottom and liquid near the top, where it is in connection with the furnace charge) and if an electric current is passed through the resistor in the tube, then as a result of the pinch phenomenon forces will act on the liquid portion of the resistor in a radial direction so as to drive the liquid material inside. With vertical tubes these forces are horizontal and perpendicular to the axis along the whole length. The mechanical result is that the liquid metal is driven radially from the outside of the tube to the middle of the tube and then rises upward to the top of the charge and produces there a fountain.

The liquid flows up in the center and down to the periphery and down along the walls of the furnace back to the top hole of the resistor and down along the walls of the resistor. It is then driven again to the center of the resistor, whereby a very distinct circulation of the fluid bath is provided.

This is called the squirt phenomenon and is made the basis of a liquid-resistor furnace. If such a column is made the resistor in which the heat is generated by passing the current through it by means of an electrode at the bottom the heated liquid will be rapidly expelled and forced to the top against the blanket of slag, while the cooler liquid at the bottom will be sucked down into the hole near the circumference, to be in turn heated and immediately expelled with considerable force.

With a single-phase current or with direct current two such resistors are used at the bottom of the furnace; with three-phase current use is made of three such resistors.

The advantages of the furnace are its simplicity and cheapness, as it consists merely of a crucible or hearth with two suitable holes in the bottom plugged with the electrodes. The heat is generated in the material itself, and it is generated at the bottom and the bath is automatically circulated. The power-factor can be made very high and the frequency need not be abnormally low.

The author states that the larger the furnace the better, and the less will be the difficulties. The furnace currents must be at low voltage and of high amperage, and the transformer to give them is best attached directly to the bottom or side of the furnace.

The paper was discussed at some length by Messrs. Richards, Hibbert, Clamer, Saunders, Kemery and Queneau.

Two further papers on the program were one by Mr. C. Vey Holman on the advantages of Maine for electrochemical industries and one by Mr. F. P. Knight on the advantages of Keokuk, Iowa, for electrochemical industries.

A paper by Mr. W. B. Pritz on dry-cell testing dealt with results of the non-uniformity of dry-cell tests, the requirements for a satisfactory test, the effect of temperature upon dry-cell testing, and the rating of dry cells. The author finally proposed two different tests according to the purpose for which the cells are to be used, namely, for telephone service or for gas-engine ignition service. Since it is often the case that quite an interval of time may elapse between the manufacture and the installation of a cell in service, a knowledge of what may be expected during this period becomes of importance, and hence an open-circuit or "shelf-life" test is quite essential.

The next meeting of the society will be held at the end of September at Toronto, Ontario, Canada.

The president-elect, Dr. William Rodney Whitney, was born in Jamestown, N. Y., on Aug. 22, 1868. He graduated from the Massachusetts Institute of Technology with the degree of B. S. in 1890 and obtained the degree of Ph.D. at the University of Leipzig in 1896. He served for some time as instructor and associate professor of theoretical chemistry at the Massachusetts Institute of Technology before accepting his present position as director of the research laboratory of the General Electric Company. In this position he has been in immediate charge of the research work conducted by this company and has been responsible for the developments made in carbon-filament and tungsten-filament electric lamps. In addition to the A. E. S. he is a member of the American Chemical Society, the American Society for Testing Materials, the American Institute of Mining Engineers, the American Institute of Electrical Engineers, the American Association for the Advancement of Science and the Société Chémique de Paris. He translated into English Le Blanc's "Electrochemistry."

Specifications for New National Electrical Code Rubber-Covered Wire.

As pointed out in our issue of March 30, the electrical committee of the National Fire Protection Association, successor to the Underwriters' National Electric Association, drafted at its biennial meeting in New York, on March 23, new specifications for rubber-covered wire. These specifications are quite drastic as compared with those covering the old code wire and as compared with recent specifications passed by the cities of New York and Chicago, combining chemical as well as physical tests. The result will be a wire of somewhat higher cost than the old code wire; and in order to give manufacturers, contractors and dealers alike an opportunity to dispose of present stock, or to fulfill contract obligations, the specifications will not be enforced until such time as all the parties interested in the change agree is proper. Manufacturers will probably cease to turn out wire under the old specifications at once, except such as is needed to carry out present contracts.

The specifications for rubber-covered wire are contained in Rule 41, as printed in the "Construction Rules" edition of the code. The various sections of this rule have been changed as follows. Section *b* now reads:

"The insulation must consist of a rubber compound, homogeneous in character, adhering to the conductor or to the separator, if one is used, and of a thickness not less than that given in the following tables Nos. 41 *e* and *f*."

Section *c* of the rule has been greatly amplified and much of old Section *d* incorporated in it. This section now reads as follows:

"Any 1-ft. sample of completed covering must show a dielectric strength sufficient to resist throughout five minutes the application of an e.m.f. proportionate to the thickness of insulation in accordance with the following table:

Thickness in 64ths Inches.	Breakdown Test on 1 Ft.
1	3,000 volts A. C.
2	6,000 " "
3	9,000 " "
4	11,000 " "
5	13,000 " "
6	15,000 " "
7	16,500 " "
8	18,000 " "
10	21,000 " "
12	23,500 " "
14	26,000 " "
16	28,000 " "

"The source of alternating e.m.f. shall be a transformer of at least 1 kw capacity. The application of the e.m.f. shall first be made at 3000 volts for five minutes, then the voltage increased by steps of not over 3000 volts, each held for five

minutes, until the rupture of the insulation occurs. The tests for dielectric strength shall be made on a sample wire which has been immersed in water for seventy-two hours. One foot of the wire under test is to be submerged in a conducting liquid held in a metal trough, one of the transformer terminals being connected to the copper of the wire and the other to the metal of the trough."

Section *d* as finally revised is as appended:

"Every length of completed wire or cable must be tested after not less than twelve hours' immersion in water and while still immersed by the application for one minute of an alternating-current voltage derived from apparatus of ample capacity, the test voltages to be those given in the tables of 41 *e* and *f*.

"After this voltage test every length of completed wire or cable while still immersed must show an insulation resistance after one minute electrification not less than the values given in 41 *e* and *f*.

"Any length of completed wire or cable may be tested during thirty days' immersion in water and must show not less than 50 per cent of the insulation resistance required after the twelve hours' immersion.

"The results of insulation test at different temperatures to be reduced to a basis of 60 deg. Fahr. (15.5 deg. C.) by using the multipliers in the following table:

Temperature, Degrees Fahrenheit.	Multiplier.
50–52	.69
53–55	.78
56–58	.88
59–61	1.00
62–64	1.12
65–67	1.27
68–70	1.43
71–73	1.60
74–76	1.81
77–79	2 04
80–82	2.29
83–85	2.58

Section *e*, specifying insulation for voltages ranging between 601 volts and 3500 volts, has been corrected as given below:

"Thickness of insulation, voltage tests and minimum insulation resistance to be in accordance with the following tables. The test voltages are to be for one minute. The insulation resistances are after one minute electrification and at 60 deg. Fahr. (15.5 deg. C.).

TESTS ON COMPLETED LENGTHS 0-600-VOLT CLASS.

Type Letters R. S.

Size.	Thickness of Insulation.	Megohms per Mile After Twelve Hours' Immersion.	Voltage Test One Minute.
14	3–64	300	1500
12	3–64	250	1500
10	3–64	225	1500
8	3–64	200	1500
6	1–16	200	2000
4	1–16	150	2000
2	1–16	125	2000
1	5–64	150	2500
1–0	5–64	125	2500
2–0	5–64	125	2500
3–0	5–64	100	2500
4–0	5–64	100	2500
225,000 circ. mil.	3–32	100	3000
300,000 " "	3–32	100	3000
400,000 " "	3–32	100	3000
500,000 " "	3–32	100	3000
600,000 " "	7–64	100	3500
700,000 " "	7–64	100	3500
800,000 " "	7–64	100	3500
900,000 " "	7–64	100	3500
1,000,000 " "	7–64	100	3500
1,250,000 " "	1–8	100	3500
1,500,000 " "	1–8	75	3500
1,750,000 " "	1–8	60	3500
2,200,000 " "	1–8	50	3500

"Rule 41, Section f.—Tests on completed lengths, 601 to 7000 volt classes.

MAXIMUM OPERATING VOLTAGE.

1500 *V. Type Letter R. S.*—15.

Size.	Thickness of Insulation.	Insulation Resistance, Megohms.	Volts Test.
B. & S. Gage			
14–8	1–16	600	4000
7–2	5–64	300	4000
1–4–0	3–32	200	4000
Circular Mils.			
225,000– 500,000	7–64	175	4000
525,000–1,000,000	1–8	150	4000
Over 1,000,000	9–64	100	4000

MAXIMUM OPERATING VOLTAGE.

2500 *V. Type Letter R. S.*—25.

Size.	Thickness of Insulation.	Insulation Resistance, Megohms.	Volts Test.
B. & S. Gage			
14–8	3–32	700	6250
7–2	3–32	350	6250
1–4–0	7–64	250	6250
Circular Mils.			
225,000– 500,000	1–8	200	6250
525,000–1,000,000	9–64	175	6250
Over 1,000,000	10–64	125	6250

MAXIMUM OPERATING VOLTAGE.

3500 *V. Type Letter R. S.*—35.

Size.	Thickness of Insulation.	Insulation Resistance, Megohms.	Volts Test.
B. & S. Gage			
14–8	4–32	850	8750
7–2	4–32	450	8750
1–4–0	4–32	300	8750
Circular Mils.			
225,000– 500,000	9–64	225	8750
525,000–1,000,000	10–64	200	8750
Over 1,000,000	11–64	150	8750

MAXIMUM OPERATING VOLTAGE.

5000 *V. Type Letter R. S.*—50.

Size.	Thickness of Insulation.	Insulation Resistance, Megohms.	Volts Test.
B. & S. Gage			
14–8	6–32	1000	12,500
7–2	6–32	650	12,500
1–4–0	6–32	450	12,500
Circular Mils.			
225,000– 500,000	6–32	300	12,500
525,000–1,000,000	6–32	225	12,500
Over 1,000,000	7–32	175	12,500

MAXIMUM OPERATING VOLTAGE.

7000 *V. Type Letter R. S.*—70.

Size.	Thickness of Insulation.	Insulation Resistance, Megohms.	Volts Test.
B & S. Gage			
14–8	8–32	1200	17,500
7–2	8–32	800	17,500
1–4–0	8–32	550	17,500
Circular Mils.			
225,000– 500,000	8–32	400	17,500
525,000–1,000,000	8–32	275	17,500
Over 1,000,000	9–32	200	17,500

Section *g* reads as follows:

"Lead-covered wires and cables for interior work only. (Type letters R S L.)

"Construction of lead sheath rubber-insulated conductors 0-600 volts. Thickness of insulating wall same as for braided cables, all cables to be covered with a compound-filled tape or braid over the insulating wall. If braid is used it shall be of such thickness as to increase the required diameter over the insulating wall by at least 1/32 in., and must comply with the requirements for braid on braided conductors.

"If tape is used it must not be less than 1/64 in. thick and must lap at least one-quarter of its width. The width of the tape used should not exceed twice the square root of the diameter of the conductor over the insulating wall; i. e., 500,000 circ. mil 3/32 rubber, tape not to exceed 2 in. in width; No. 14, 3/64 rubber, tape should not exceed 0.8 in. in width.

"The lead on single-conductor cables, 0-600 volt class, sizes 2 B. & S. and smaller, both solid and stranded, to be not less than the thickness of rubber called for by Rule 41-*e*. On larger sizes the thickness of lead to be not less than the thickness of insulating wall called for, less 1/64 in.; i. e., thickness of lead on No. 2, 1/16 in.; on 1,000,000 circ. mil, 3/32 in. On multiple conductor cables, thickness of lead to be that called for by single conductor, having same diameter over the insulation as the multiplier conductor cable has over the bunched insulated conductors.

"Rubber-insulated and lead-sheathed cables, 601 to 7000 volt classes inclusive (type letters R S L-15, R S L-25, etc.) shall comply with Rule 41-*f*, and the lead sheath shall be the same as called for in 0-600-volt class, having same diameter under the lead as 601-7000-volt conductor.

"(Electrical test on finished leaded cables the same as on braided.)"

The physical tests to which all rubber-covered wire will hereafter be subjected are contained in Section *h*, as follows:

"All physical tests to be made at a temperature between 60 deg. Fahr. and 90 deg. Fahr. All test samples to be kept at a temperature within this range for at least two hours before the tests are made.

"1. The rubber compound or other approved insulation must be sufficiently elastic to comply with a test made as follows:

"A sample of wire about 20 in. long shall have the braid and insulation removed for about 2 in. at each end, leaving the braid and insulation on balance of sample. One end of the bare copper should be fastened to a clamp on a shaft of the diameter given below and a weight as given below attached to the other end of the bare copper wire. The shaft shall then be revolved ten times in ten seconds, wrapping the sample in a close wind around the shaft. With the tension left on the sample it should then be immersed in water for twenty-four hours, immediately after which it should, while still immersed, be subjected to 1500 volts alternating current for one minute The braid shall not crack under the above test.

	B. & S.	Mils.	Pounds.
Diameter of shaft.....	No. 14 wire	170	Weight 10
" " "	12 "	190	" 10
" " "	10 "	275	" 12
" " "	8 "	375	" 15

"2. The insulating covering shall be tested for softness as follows:

"A sample of wire to have the braid removed without injury to the insulation for a distance of about 2 in., and the exposed surface held against a flat surface and subjected to the pressure of a hard phosphor bronze-edged tool, the sharpness of whose edge shall be that obtained by two surfaces forming an angle of 90 deg. with each other.

"With the tool edge at right angles to the length of the wire a vertical pressure of 8 lb., applied perpendicular to the flat surface for fifteen minutes, shall not cut through the insulation and complete an electric circuit as indicated by a 16 cp, 110-volt carbon lamp in series with the tool and wire conductor.

"3. Any rubber compound used as insulation shall be tested for permanent set, elongation and tensile strength as follows:

"*New Wire.*—A test piece taken from the wire, having insulation less than 5/64 in. thick, shall have marks placed 2 in. apart, and shall be stretched longitudinally at the rate of 12 in. per minute till the marks are 5 in. apart, and then be immediately released and a measurement taken thirty seconds thereafter, when the distance between the marks must not exceed 2.5 in. The test piece shall then be stretched until the marks are 6 in. apart before rupture. The tensile strength shall not be less than 400 lb. per square inch, calculated upon the original cross-section of the test piece before stretching.

"Test pieces from wire having insulation 5/64 in. thick or over shall be tested in a similar manner, but shall be stretched to 4 in. instead of 5 in., and must not break until stretched 5 in., and shall have a tensile strength of 400 lb. per square inch.

"*Wire Tested at Any Time Up to One Year from Date of Manufacture.*—A test piece taken from wire having insulation less than 5/64 in. thick shall have marks placed 2 in. apart, and shall be stretched longitudinally at the rate of 12 in. per minute till the marks are 4 in. apart, and then be immediately released and a measurement taken thirty seconds thereafter, when the distance between the marks must not exceed 2.5 in.

"Test pieces from wire having insulation 5/64 in. or over shall be stretched at 3½ in. instead of 4 in."

The chemical tests are incorporated in a new Section *j* as follows:

"Five chemical tests shall be made of the rubber compound as follows: Acetone extract, alcoholic potash extract, chloroform extract, ash and total sulphur.

"The sum total of the results of these five tests shall not exceed 80 per cent by weight of the total compounds—tests to be made according to Underwriters' Laboratories' specifications."

The ash test shall be supplemented by tests to determine the quality of substances other than vulcanized rubber which are combustible but not soluble in acetone, alcoholic potash or chloroform and any such substance shall be counted as ash.

Decisions on Price Agreements by the United States Supreme Court.

The legality of price agreements is involved in a case decided by the United States Supreme Court on April 3. The case relates to an agreement affecting trade in proprietary medicines. The decision was written by Justice Hughes. A dissenting opinion was rendered by Justice Holmes. The Dr. Miles Medical Company, of Elkhart, Ind., sought to restrain the John D. Park & Sons Company, of Cincinnati, Ohio, from selling at cut prices the medicines manufactured by the former corporation. The manufacturer had contracts with jobbers and wholesale and retail dealers in the United States, prescribing prices at which its goods should be sold at retail. It was urged by the manufacturer that the company against which it brought suit conducted a wholesale drug business and by inducing other dealers to violate their contracts acquired medicines and sold them at such prices that they were resold to the public at cut rates. The lower court dismissed the bill for want of equity, and its judgment was affirmed by the higher court.

Justice Hughes holds that it is obvious that the agreements restrain trade. The manufacturer, although employing a secret process, urged an analogy to rights secured by letters patent. The purpose of the patent law is to stimulate invention by protecting inventors for a fixed time in the advantages that may be derived from exclusive manufacture, use and sale. A decision is quoted in which Chief Justice Marshall said: "It is the

reward stipulated for the advantages derived by the public from the exertions of the individual, and is intended as a stimulus to these exertions. The public yields nothing which it has not agreed to yield. It receives all which it has contracted to receive. The great object and intention of the act is to secure to the public the advantages to be derived from the discoveries of individuals, and the means it employs are the compensation made to these individuals for the time and labor devoted to these discoveries, of the exclusive right to make, use and sell the things discovered for a limited time."

The court holds that whatever right a manufacturer may have to project his control beyond his own sales must depend not upon the inherent power incident to production and original ownership, but upon agreement. The earlier doctrine of the common law with respect to contracts in restraint of trade has been substantially modified in adaptation to modern conditions, but the public interest is still the first consideration. To sustain the restraint it must be found to be reasonable both with respect to the public and to the parties, and it must be limited to what is fairly necessary in the circumstances of the particular case for the protection of the covenantee. Otherwise restraints of trade are void as against public policy.

If there be an advantage to a manufacturer in the maintenance of fixed retail prices, the question remains whether it is one which he is entitled to secure by agreements restricting the freedom of trade on the part of dealers who own what they sell. The complainant could fare no better without his plan of contracts than could the dealers themselves if they formed a combination and endeavored to establish the same restrictions. Agreements or combinations between dealers having for their sole purpose the destruction of competition and the fixing of prices are injurious to the public interest and void.

Where commodities have passed into the channels of trade and are owned by dealers, the validity of agreements to prevent competition and to maintain prices is not to be determined by the circumstance whether they were produced by several manufacturers or by one, or whether they were previously owned by one or by many. The complainant having sold its product at prices satisfactory to itself, the public is entitled to whatever advantages may be derived from competition in the subsequent traffic.

Justice Holmes in his dissenting opinion said that by a slight change in the form of the contract the plaintiff could accomplish the result desired in a way that would be beyond successful attack. If it should make the retail dealers also agents in law as well as in name, and retain the title until the goods left their hands, he could not conceive that even the present enthusiasm for regulating the prices to be charged by other people would deny that the owner was acting within his rights. The most enlightened judicial policy was to allow people to manage their own business in their own way unless the ground for interference was very clear. He confessed that in inquiring on what ground there was interference in the present case he was in a minority as to larger issues than were concerned in this case. He could not believe that in the long run the public would profit if this court permitted knaves to get unreasonable prices for some ulterior purposes of their own and thus to impair and even to destroy the production and sale of articles which it was assumed to be desirable that the public should be able to get. Justice Holmes thought that the importance of the question, and the popularity of what he deemed mistaken notions, made it his duty to express his view in dissent.

Ohio Commission News.

Amended in such a manner as to make it stronger than the original measure, the Winters public utilities bill was passed by the Ohio House of Representatives on April 5. For some mysterious reason the fierce opposition to the amendments proposed by Representative Lawrence K. Langdon on the previous day had disappeared and their adoption came about with ease. There is a suspicion on the part of some that the opponents will attack the bill in the Senate and defeat it, if possible, in the same manner they did the Woods bill a year ago. The vote on the bill stood 90 to 14.

As the bill stands amended the commission will have power to prevent public service companies from keeping any books or records except those that may be approved by the commission or required by the Interstate Commerce Commission or State laws. This is done for the purpose of securing a system of uniform accounting.

An important change in the bill was made by the provision for establishment of standard commercial units of service by the commission and each company must furnish data in units, depreciation, wages, legal service, taxes, rentals, materials, receipts from by-products, net cost, gross and net profits, dividends and interest, surplus and reserve, and prices per unit to consumers. The idea is to get the cost of production in units in order that the commission may be in better position to consider the various questions that will come before it.

Public-service companies must provide for the interchange of service by connecting tracks, wires, etc., and telephone companies must give a complete service through joint use of switchboards and equipment if the commission so orders. However, this provision safeguards companies in doing this, so that they may not take advantage or impose upon each other in any way. Telephone companies may consolidate only by the purchase of the franchises and business of competitors on consent of the commission.

Jurisdiction is given to the commission over all utilities except those which receive their franchises directly from a municipality and in the case of such it may sit as a board of arbitration between the municipality and the utility. It has nothing to say as to rates in the original franchise and may act only in the adjustment at the beginning of ten-year periods.

Through an amendment proposed by Representative Edwards the House of Representatives went on record for the second time this session as being opposed to municipal ownership. By a vote of 42 to 59 his amendment, giving cities the right to purchase by voluntary offer or condemnation railways, light plants and water-works, was defeated.

New York Commission News.

The New York Public Service Commission, Second District, has received a petition from the Syracuse Lighting Company asking for authority to issue $470,000 par value of its extension and improvement 6 per cent ten-year gold bonds. The proceeds of the bonds are to provide for the laying of trunk mains, for extensions to its distributing system and for improvements at works and stations, and for the reimbursement of moneys actually expended from income within five years for capital purposes.

The commission has received a complaint from Mr. William S. Massoneau, president of the village of Red Hook, Dutchess County, directed against the Red Hook Light & Power Company. Because of a dispute as to the amount to be paid for street lamps during the last six months of 1910 the company served a notice upon the village that if the amount was not paid by March 31 the street lamps would be shut off, and the streets of the village are now left in darkness. The commission is asked to require the company at once to renew its street-lighting service and to continue without interruption pending the adjustment of the disputed bill. The commission made an order requiring the company to show cause why it should not be required forthwith to furnish the village with street-lighting service.

The North Avenue Presbyterian Church, of New Rochelle, has filed with the commission a complaint against the minimum-service charge imposed by the Westchester Lighting Company upon a 5-hp motor in use by the church. This motor is used solely to run a fan for ventilating purposes during serv-

ices. The company makes a minimum-service charge of $1 per horse-power per month, or a total of $5 per month, which the church is obligated to pay whether that value of energy is used or not. The church alleges that the actual monthly consumption of energy at the stated price of 10 cents per kw-hour does not exceed $1 per month. The church complains that this minimum-service charge is grossly excessive, unjust and unreasonable and in violation of the provisions of the Public Service Commissions law.

Mr. Neile F. Towner, as attorney for the Municipal Gas Company, of Albany, appeared before the commission in answer to an order to show cause why it should not at once restore its gas and electric service to Mr. James H. Farley, who had complained to the commission that the company had arbitrarily shut off both the gas and electrical service because of his refusal to pay a bill for gas mantles and other fittings furnished him by the company some months ago. The bill is in dispute and the company sought to enforce its collection by resorting to the means of depriving the complainant of the lighting service supplied by it.

The company asked for more time in which to put in its answer and was given until April 17, upon the condition that the service would meantime be restored in Mr. Farley's store. The issue raised involves a question of law. Under Section 65 of the Transportation Corporations law a corporation furnishing gas or electricity may prevent the service from entering the premises of any consumer who may neglect or refuse "to pay the rent or remuneration due for the same or for the wires, pipes or fittings let by the corporation." There seems to be some doubt as to the legal right of the company to shut off the supply of gas or electricity by reason of complainant's refusal to pay a bill for gas fittings sold to him by the company.

The commission has authorized the Katonah Lighting Company to exercise privileges contained in a franchise granted by the town of Lewisboro, County of Westchester, for the extension of electric lighting service to that town. The company is also authorized to issue its common capital stock to the amount of $45,000 for the purpose of extending and improving its plant.

On April 13 at New York a further hearing will be given on the application of the New York, Westchester & Boston Railway Company for permission to exercise franchises and for changing the route of its main line from North Street in New Rochelle to a point in Port Chester on the boundary line between this State and Connecticut. Also the application of the Westchester Street Railroad Company for permission to exercise franchises for the extension of a street railway in the town of Harrison, Westchester County, will be heard.

On April 13 and 14 at New York the commission will give a hearing on the complaints of residents of various towns in Westchester County against the Westchester Lighting Company as to the price of gas and electricity. On April 14 at Olean the commission will take up the complaints of various towns along the lines of the Western New York & Pennsylvania Traction Company as to the increase recently made in passenger fares on that line.

The commission has received a complaint from Dr. Thomas R. Sheldon, of Red Hook, directed against the Red Hook Telephone Company. The complaint alleges that the toll charge of 15 cents between the exchanges at Red Hook and Rhinebeck is unjust, unreasonable and excessive. Complainant alleges that he pays the regular rentals both at his residence in Rock City and at his residence in Rhinebeck for local telephone service and that the charge of 15 cents is made in addition to the local service charge. The commission is asked to fix a reasonable charge between these exchanges.

Maryland Commission News.

The Maryland Public Utilities Commission has concluded its first investigation of the utilities corporations in the State. Mr. Charles E. Phelps submitted last week to the Public Service Commission, of which he is chief engineer, a report of gas and electric tests made by him during the three months ended April 1. Eleven companies furnishing these commodities located in every part of Maryland were included in the examination. Candle-power and heating-power and pressure were considered by Mr. Phelps in making the examinations. The report is favorable to the gas and electric companies of Maryland. Twenty is established as the standard for candle-power for gas. Mr. Phelps found that the candle-power exceeded this, the average for January being 20.48. In only one instance was the heating power less than 600, which is the standard amount. Referring to the gas supply of Baltimore City, Mr. Phelps says it is above the standard both for quality and purity. During the three months when the tests were made 6298 gas meters and 1867 electric meters were subjected to an examination. Fifteen complaints were made of gas meters. Four of them measured correctly and eight were too slow, giving the consumer the advantage. Two were slightly fast and one was very fast. Complaints were also made of six electric meters. Four of the number were slow and the other two were fast.

The Western Union Telegraph Company filed a reply to the charges of the Belvedere Hotel Company with the commission last week, in which it denied the existence of any connection with the Postal Telegraph Company. The Belvedere Hotel Company filed a complaint a few weeks ago that the two corporations had acted in "illegal combination" in removing their offices and instruments from the hotel. The reply of the Postal Telegraph & Cable Company to the charges was also filed with the commission last week. The Postal denies that there existed any illegal combination with the Western Union Telegraph Company, as charged by the hotel, and denies further that an office in the hotel was necessary for the convenience of the hotel patrons and residents of that section of the city. The company adds that it is willing to restore an office in the hotel provided a suitable location be offered. The commission will await a statement from the hotel company as to whether the answers are satisfactory before deciding whether the case shall have a hearing.

A special meeting of the Morrell Park Improvement Association was held last week in the interest of getting a car line for the Washington Road. About 500 people attended the meeting and it is said that more than 5000 would be benefited by such a car line. At present these people are forced to walk from a quarter of a mile to three miles for a car. The association will ask the United Railways & Electric Company to extend the Columbia Avenue line one mile and a half along the Washington Road or to Canton Avenue. An attorney has been retained by the association to present the matter to the Public Service Commission.

Massachusetts Legislative News.

Chairman George G. Crocker, of the Boston Transit Commission, appeared before the joint committees upon metropolitan affairs and railroads on April 6 on behalf of steam-railroad electrification in the Boston district. Mr. Crocker said that as spokesman for the minority of the Joint Commission on Metropolitan Improvements, which favored early beginning of electrification through legislative enactment, he believed that electricity has been shown to be a thoroughly practicable motive agent. He emphasized the point that nothing in the utterances of Vice-president McHenry, of the New York, New Haven & Hartford Railroad, shows that a properly planned electrification system will not prove profitable. Mr. Crocker said that the fact that at present more than three times the number of passengers are handled in Boston that are passed through the Grand Central Station in New York is a strong argument in favor of electricity. A higher traffic density is one of the best reasons for electrifying. Because it has been found that to operate in one place 1000 cars per day in 100 trains of ten cars each costs more by electricity than by steam it by no means

follows that electricity will be more costly than steam in another place where the volume of traffic is three times as great and where the conditions require that it be carried in 600 trains of five cars each. Mr. Crocker said further: "I submit that as compared with steam electric traction works to better advantage when the traffic requires a large number of separate train units than when it can be concentrated into a smaller number of large train units, and the fact that there are twenty or more branch lines which must be operated in and around Boston either by steam or electricity is a condition which is not adverse but, on the contrary, is favorable to the substitution of electricity for steam. * * * The possibility of using the multiple-unit system on the branch lines around Boston is a further condition advantageous to the use of electricity."

Mr. Crocker further pointed out that no account had been taken of so-called real-estate salvage through improvement of property by electrification in the studies of the railroads, and contended that only the merest hypothetical consideration had been given this point by the majority of the Joint Commission. Electrification eliminates the necessity of costly roofed structures used now because of smoke and gases in terminal stations. The speaker made a strong argument against the smoke nuisance, suggesting that it is not unlikely that it actually shortens life in a manner which is more serious in the aggregate than railroad accidents. He firmly believed that if electrification of the unified Boston & Maine and New Haven systems is carrried forward on the lines suggested by Vice-president McHenry, including both passenger and freight service, the result, taking all elements into consideration, will be notably profitable to the company.

A striking argument in this connection was submitted by Mr. Crocker. He stated that the present passenger traffic to and from the North and South Stations at Boston is about 60,000,000 per annum. The cost of electrification of the entire metropolitan district is estimated at $40,000,000. Five per cent on this is $2,000,000 per year. An increase of 20 per cent in the present passenger traffic, each passenger riding an average of ten miles within the electrified district and paying an average fare per mile of 1.6 cents—the average of the State per mile—would add the $2,000,000 to the gross earnings. He emphasized the fact that electrified service always tends to increase the volume of travel. At the Grand Central, in New York an increase of 12 per cent occurred between 1908 and 1910 in spite of the confusion incidental to the changes made at the terminal.

In closing, Mr. Croker said that he believed that the New Haven company fully intends to electrify its lines as promised before the Boston & Maine lease, but that compulsory legislation is essential in order to express the dissent of the State from the unsatisfactory report of the majority of the Joint Commission. Unless the State announces its intentions to hold the company up to its professions, the report itself will furnish good ground for claiming that it should not be expected to do anything which is of so little importance to the public, which will cost so much and be so unprofitable. Chairman Crocker was followed by Prof. George F. Swain, of the Joint Commission, who reiterated his well-known views that legislation compelling the adoption of electric motive power at present is undesirable, and that if the New Haven tunnel for electric service is built by legislative sanction under Boston Harbor electrification will proceed from that step as an economic extension to other lines.

Wisconsin Commission News.

The case involving an application for an increase in rates by the Troy & Honey Creek Telephone Company has been dismissed by the Wisconsin Railroad Commission. The company alleged that the revenues derived under the present rate of $1 per month for residence or business telephones did not return a reasonable rate of interest upon the investment. The rates asked for were $1.25 and $1.50 per month for residence and business telephones respectively. There was opposition on the part of the subscribers to this increase on the grounds that the service was not satisfactory and that, under proper management, the present rates should yield an ample return upon the investment.

The commission has handed down its decision in the matter of the application for an increase in rates by the Milton & Milton Junction Telephone Company. The company's present rates are as follows: $1.50 for business and residence individual lines; $1 for business and residence four-party selective; $1.25 for rural telephones. The increase in the cost of labor, material and supplies is the reason assigned for the increase in rates. The rates asked for are as follows: Business telephones, individual, $2; four-party, $1.50; residence telephones, individual, $1.50; four-party, $1; rural telephones, $1.50.

It developed at the inquiry that the company had maintained no depreciation account prior to the last fiscal year. As a result of this negligence the renewal requirements will undoubtedly exceed the amount allowed for depreciation. Yet, as the commission points out, this does not justify the company in loading the cost of past depreciation on the telephone users of the future. The operating revenues under the present rates are sufficient to give a fair return upon the investment, with depreciation computed at 7 per cent. The proposed rates would yield too great a rate return. Furthermore, the commission did not consider that the difference in the cost of serving the rural subscribers was as high as the proposed rate would indicate, It was thought advisable to reduce the proposed rate for rural telephones from $1.50, as requested, to $1.25, and to authorize the company to adopt its proposed schedule with this modification.

The commission has authorized the Wisconsin Electric Railway Company to issue $83,000 par value of 5 per cent, twenty-year first-mortgage gold bonds, in denominations of $1,000 each. The issue is to be secured under a mortgage executed to the Wisconsin Trust Company of Milwaukee. The bonds are to be sold for cash and for not less than 85 per cent of their par value for the purchase of electric railway property and equipment, the cost of extensions and additions to the property of the company.

The Great Northern Pail Company has received a franchise to do a general lighting business in the village of Gillet, Wis., and to light the streets of the village.

The Jefferson Electric Light Company has been empowered to put into effect the following schedule of rates: 16 cents per kw-hour for the first sixty hours' use per month of the active connected load; 10 cents for all excess. A discount of 10 per cent may be allowed. The active connected load is to be as follows: Class A, consisting of residences, public buildings, etc., 45 per cent active; Class B, consisting of schools, churches and industrial establishments closing not later than 6 p. m., 50 per cent active; Class C, consisting of stores, banks, saloons and all others, 60 per cent active. Street lighting, with 32-cp incandescent lamps operating on a moonlight, all-night basis, is to be furnished for $18 per lamp per year.

Canadian Hydroelectric Commission News.

It is reported on the authority of the local distributing company at Windsor that an agreement has been practically closed between that company and the Michigan Railway for a large block of hydroelectric power for use in the Detroit River tunnel. The Detroit Edison Company is now furnishing power to the tunnel company under a ten-year contract, which, however, is is understood, is not exclusive, and the power now being used represents but a small portion of what will be required by the Michigan Central Railway.

The City Council of Toronto at its meeting on April 3 refused to approve the recommendation of the board of control that Mr. P. W. Ellis be appointed as the city's representative

on the proposed commission to manage the city's hydroelectric distribution plant and business.

On April 6 the steam-generating equipment at the Stratford (Ont.) municipal plant was shut down and the entire service for the city is being furnished by Niagara Falls power from the commission's transmission line to western Ontario. The steam plant will, however, be kept in reserve.

Representatives from nineteen municipalities in eastern Ontario met at Brockville on April 7 for the purpose of considering terms and conditions of hydroelectric power to be furnished them through the agency of the Hydroelectric Commission. Hon. Adam Beck, chairman, accompanied by Chief Engineer P. W. Sothman, stated that a contract had been entered into with the New York & Ontario Power Company, of Waddington, N. Y., with the option of securing 15,000 horse-power at a total cost of $657,000. In addition, Mr. M. F. Beach, owner of a power course at High Falls, had made an offer which would also cover the eastern portion of the province, with a distributing station at Kingston.

Mr. Beck read the contract made with the New York & Ontario Power Company, of which Mr. J. Wesley Allison, of Morrisburg, is the promoter. Mr. Beck claimed that the contract was more advantageous than any made in western Ontario. The rates throughout this contract would be higher than from the Niagara Falls source, but transmission would be cheaper on account of the shorter distance from the generating plant. After the expiration of ten months from the execution of the contract the company is to deposit $100,000 that it will supply and deliver at Morrisburg from 2000 to 5000 horse-power, and, later, upon one month's notice from the commission, to deliver in blocks until the maximum is reached. Within eighteen months the commission must give notice to the company that it will go on with the work.

AMERICAN ELECTRICAL ENGINEERS—No. XXIX.

E. N. Lake.

Edward Nelson Lake was born June 13, 1869, at Austin, Minn., and from 1876 to 1886 lived in Alabama, where he attended public and private schools. After teaching in country and city schools in the State of Florida for several years he took a course in civil engineering at the National Normal University of Lebanon, Ohio, receiving the degree of C. E. in 1889. During his last year at the school he carried on the work of one of the instructors who was forced to be absent through illness.

After graduation Mr. Lake served as instructor in the Florida Agricultural College at Lake City, where he devoted four or five hours daily to special electrical work, including such laboratory work as the facilities at the institution permitted. In 1893 he concluded to take up electrical engineering as a profession, and decided that under the circumstances the best method of training would be through direct contact with practical work, supplemented by reading and study upon subjects connected with the work in hand from time to time. This method was followed with more or less system and constancy of purpose.

The first twelve months were spent by Mr. Lake in armature winding and machine-shop work with the Independent Electric Company, Chicago, including some experimental work under Mr. Elmer A. Sperry; the following year he was engaged as wireman with the Chicago Edison Company, and the next year as electrician in the industrial power plant of Norton Brothers at Maywood, Ill. Another year was passed as construction foreman with the Topeka Edison Company, followed by a year as electrical contractor at Wheaton, Ill., and a similar period as superintendent for Mr. Charles A. Pratt, Chicago, a consulting engineer, in applying motors to industrial plants. After serving for a year and a half as head draftsman in the switchboard department of the Western Electric Company, Mr. Lake joined the engineering staff of the Chicago Edison Company, with which he remained for three years, his work principally being in connection with the three-phase distribution system of this company, which was at this time changed over from 4500 volts to 9000 volts. During this period he designed and supervised the construction of various rotary converter and battery substations. In 1903 he became manager of the switchboard department of the J. Lang Electric Company, of Chicago, having charge of the design, construction and sale of the product, which included both standardized and special switchboards. In 1905 he became connected with the Arnold Company of Chicago. Part of his work during this engagement was connected with the design and supervision of the construction of transmission lines, substations and low-tension distribution system of the Elgin and Belvidere Electric Railway.

Mr. Lake also assisted in the preparation of the plans and had charge of certain schedules in the valuation by the Traction Valuation Commission of the properties of the Chicago City Railway Company and the Chicago Union Traction Company. In 1907 he became division engineer of the division of

E. N. Lake.

electric transmission and distribution of the Board of Supervising Engineers, Chicago Traction. The work of this body was the preparation of plans and specifications for, and supervision of, the rehabilitation of the street railway systems of the City of Chicago. Recently Mr. Lake has joined the staff of the Stone & Webster Engineering Corporation, and he is at present engaged upon plans for the new alternating-current distribution system of the Boston Elevated Railway system.

A number of patents have been granted to Mr. Lake, among which are the following: An electro-mechanical operating device for high-voltage switches; a form of conduit used largely in the high-tension systems of Chicago, and a panel-board for office buildings designed to simplify the changing of the circuits on meters, in order to make quickly and easily changes in meter connections in case of changes in the occupancy of floor space. He is a member of the American Institute of Electrical Engineers, American Society of Civil Engineers, American Electric Railway Association, Western Society of Engineers and American Society for Testing Materials.

CURRENT NEWS AND NOTES.

Iowa Convention.—The annual convention of the Iowa Electrical Association will be held in Davenport, Ia., on April 19, 20 and 21. Mr. W. N. Keiser, Union Electric Company, Dubuque, Ia., is secretary of the association.

Electricity in Gas Works.—At the new coal gas works at Providence, R. I., all the machinery of the works is operated by electricity, except that of the condenser and purifier houses, which is operated by steam. The generating equipment comprises two 300-kw, 220-volt direct-current generators. Electricity is also the only source of lighting used in the condenser, purifier and tar pump houses.

Cost of City Lighting in Denver.—During 1910 the City of Denver paid $161,694 for its electrical street lighting, no other form of street lighting being in use. Of this amount $20,870 was for ornamental lighting on the three principal business streets and $3,147 for other special street and boulevard illumination. The Denver Gas & Electric Company returns $50,000 yearly for its franchise.

New German Patent Law.—As the result of a petition of the German Machine Manufacturers' Association to the imperial government, asking the abrogation of the German-American patent agreement of Feb. 23, 1909, a new bill has been taken up by a committee of the Reichstag. The petitioners claim that Americans have an advantage in competition, as they are not compelled to manufacture in Germany, as are the German holders of patents.

High Towers for Wireless.— The experiments that have been in progress at Brant Rock, Mass., for two years, under the direction first of the Navy Bureau of Equipment and later of the Bureau of Supplies, for the ultimate establishment of a very powerful wireless system have so far succeeded that a decision has been made to construct three or four steel towers 450 ft. high at Fort Myer, Washington, D. C., as the land base of the system. This will give the system a radius of at least 1500 miles.

Cleveland Electrical League.—The Electrical League of Cleveland held a highly successful smoker and entertainment on April 7 at the Moose Club Hall, Cleveland, over 500 members and guests being present. More than fifty new members were admitted during the evening. The principal objects of the league are to encourage the interchange of ideas, foster co-operation and eliminate misunderstandings among the members of the various competing electrical concerns through mutual acquaintance.

Boston Electric Vehicle Meeting.—A meeting in the interests of electric vehicle development will be held at the Edison Building, 39 Boylston Street, Boston, Mass., on Monday evening, April 17. At that time formal steps will be taken to organize a New England Section of the Electric Vehicle Association of America, and a talk will be given by Mr. D. B. Strickland, of the Shepard, Norwell Company, Boston, on "The Economy of Delivery Service by the Use of Motor Vehicles." It is expected that the speaker will discuss plans for a co-operative electric vehicle delivery organization, which has lately been considered by some of the larger department stores in Boston.

Ships Must Have Wireless.—The Secretary of the Department of Commerce and Labor has notified the collector of the port of New York that all ships leaving United States ports after July 1 next which carry fifty passengers and which ply between ports more than 200 miles apart must be equipped with wireless-telegraph apparatus capable of maintaining communication over distances of at least 100 miles. The department is now engaged in preparing regulations for the enforcement of this act, which was passed June 24, 1910. It has been determined to accept as evidence of the competence of operators the certificate covered by the service regulations annexed to the Berlin International Radio-Telegraphic Convention.

Proposed Buffalo-Pittsburgh Electric Railway.—It is said that recent negotiations make it probable that Buffalo and Pittsburgh may be connected by electric railway by way of Erie, Pa. According to the report the electric road running from Meadville, Pa., to Cambridge Springs, Conneaut Lake and Linesville has come under the control of the same interests that own the line running from Pittsburgh to New Castle, Sharon and Sharpsville. All that is needed to give Pittsburgh electric railway connection with Erie, and, therefore, with Buffalo, is the filling in the gap between Sharpsville and Linesville, giving service to the entire Shenango Valley. It is reported that Mr. F. F. Curtze, of Erie, has said that this missing link will be built within a short time.

Electric Club of Chicago.—At the meeting of the Electric Club of Chicago on April 5 Mr. W. J. Hagenah, chief statistician of the Wisconsin Railroad Commission, who was to have addressed the club on the workings of that commission, was unable to be present owing to the sudden illness of a member of his family. There was, however, an interesting discussion of the public-service commission idea as applied to the State of Illinois. The death of Mr. George T. Westcott, a Chicago electrical man of many years' experience, was announced, and Mr. Albert Scheible was appointed chairman of a committee to draft suitable resolutions of condolence. The treasurer of the club reported that the cash balance on hand was $3,871.30. It was also announced that the club will hold a smoker and evening entertainment on April 27 at the Illinois Athletic Club.

Model Downtown Streets for Chicago.—The Chicago Association of Commerce has appointed a committee to be known as the committee on model downtown streets. This committee is authorized to employ an engineer to study the situation and prepare a plan for improving the central business district. The undertaking is the result of a report to the executive committee of the association made by a special committee of which Mr. Bion J. Arnold was a member. The task undertaken by the committee on model downtown streets includes a study of several methods of bettering present conditions, including a passenger subway under the streets, public-utility galleries under the streets, permanent street surfaces, broad sidewalks and brilliant illumination at night. The chairman of the new committee is Mr. August Gatzert, 308 Franklin Street.

Denver Electrical Show.—On the evening of April 3 a meeting of directors and committee members of the Colorado Electric Club was held in the club rooms of the Colorado Telephone Company, Denver. Reports of the various committees were presented with particular reference to the coming Electric Show in the Denver Auditorium. As compared with last year a complete change in decorations will be made, and bunting will be dispensed with in favor of autumn floral decorations. Christmas-tree lamps will be scattered throughout these decorations, and an electric sign will be placed at each display booth. The street illumination will be largely red and white, with the emblem of the Sons of Jove very much in evidence, since their national "rejuvenation" will be held simultaneously in Denver. The "devil" will travel nightly between two towers in the lower part of the city. The basement of the Auditorium will be arranged partly as a mine and partly as a farm to show in the best possible manner the mining and irrigation progress which has resulted from uses of electricity. Sixty-six per cent of the floor space has already been taken and considerable additional room will be needed over that available at last year's show.

Electrical Contractors' Association of State of Missouri.—The next meeting of the Electrical Contractors' Association of Missouri will be held at Kansas City Saturday, June 10, 1911.

Treasury Department Adopts Electrical Weighing Machines.—As a result of the weighing frauds in the customs house of New York last year the government has just placed electrical weighing machines in the customs houses of New York and Boston.

Toledo A. I. E. E. Meeting.—At a meeting of the Toledo Section of the American Institute of Electrical Engineers held on April 7 there was a general discussion of the factors entering into the cost, production and distribution of electricity, which was led by Mr. M. W. Hansen.

Electric Light for the City of Faith.—A franchise has been granted by the City of Faith, S. D., to the Faith Light, Heat & Power Company, of which Mr. F. C. Mills is the principal proprietor. The new company will begin service within six months. Mr. M. E. Brookman, of Eagle Butte, S. D., is the engineer in charge of construction.

Northwestern University School of Engineering.—The recently established school of engineering of Northwestern University, Evanston, Ill., has now fifty students taking the full five-year course. Most of the advanced students are in their fourth year. Mr. John Fillmore Hayford, C. E., is dean of the engineering school, and Mr. William C. Bauer is professor of electrical engineering.

Attitude of Chicago's New Mayor Toward Public Utilities.—Mr. Carter H. Harrison, the newly elected Mayor of Chicago, is quoted as saying that he regards the construction of the proposed passenger subway and a uniform policy in relation to public utilities as subjects of prime importance for the new administration. He also announced his opposition to all the bills pending in the Illinois Legislature providing for public-service commissions.

American Society of Swedish Engineers.—The Capt. John Ericsson Memorial Society of Swedish Engineers, which was organized by prominent Swedish engineers in America on March 31, 1907, has established quarters in the Engineering Societies Building, 29 West Thirty-ninth Street, New York. The officers of the society are as follows: President, Mr. Carl George P. De Laval; vice-president, Mr. Carl Vesterdahl; secretary, Mr. Algot Sylven.

Meeting of the New York Company Section of the N. E. L. A.—The committees on papers and addresses and entertainment have combined to give the New York Company Section members an unusual entertainment at the April meeting, to be held in the auditorium of the Engineering Societies Building, New York, on April 17. Col. Charles J. (Buffalo) Jones is to furnish the entertainment in the form of a lecture fully illustrated with moving pictures.

Municipal Public Utilities in Los Angeles.—By recently adopted amendments to its charter the City of Los Angeles may supply its citizens with any means of heating, lighting or motor service, selling the surplus, if any, to other municipalities. It may also operate quarries, railroads, elevators, tunnels or viaducts. The Board of Public Utilities of the city has power to investigate public utilities and to establish rates, subject to the approval of the City Council.

Opening of Winnipeg Power Plant by King George.—The Board of Control of Winnipeg, Can., has had under consideration the suggestion that King George V of England should be requested to open the Winnipeg municipal power plant at Point du Bois on its completion in July. At a meeting on April 4 the board decided that Mayor Evans, when in England attending the coronation ceremonies, should endeavor to obtain the consent of the King to perform the function of opening the power plant by pressing an electric button in England connected to the machinery at the power house at Point du Bois.

Hook-Switch Instruments Demanded.—Taking advantage of a section of the ordinance under which the Chicago Telephone Company operates requiring the company to use the latest improved apparatus, aldermen of the Thirty-third Ward of Chicago have secured the passage of an ordinance requiring the company to install automatic signaling devices upon the instruments connected with the Burnside exchange. Curiously enough, it appears that the subscribers connected to this exchange are provided with the older type of instruments, requiring the subscriber to ring a bell to signal the exchange.

Colorado Springs Electrical Ordinance.—The recently passed conduit electrical ordinance of Colorado Springs has been attacked owing to a defective installation made by an electrical contractor who was formerly city electrician. As a result of some weaknesses developed in the present ordinance, an entirely new ordinance has been submitted by a committee composed of two electrical contractors and an engineer of the Colorado Springs Electric Company. This proposed ordinance is in some respects an advance and in other instances less rigid than the present ordinance and will be submitted for immediate passage. The conduit feature has become so popular as to have no opposition before the ordinance committee or City Council.

Convention of the Missouri Electric, Gas, Street Railway & Water Works Association.—The fifth annual convention of the Missouri Electric, Gas, Street Railway & Water Works Association will be held at the Jefferson Hotel, St. Louis, Mo., on April 13, 14 and 15. The following papers will be presented: "Centrifugal Pumps," by Mr. W. H. Reeves; "Lubrication," by Prof. H. B. Shaw; "The Illuminating Engineer"; "Electric Vehicle," by Mr. Herman Shoehrer; "Ornamental Street Lighting," by Mr. N. J. Cunningham; "Coal and Water Gas," by Mr. P. A. Bertrand; "District Steam Heating," by Mr. Hal. C. Kimbrough. There will be a banquet and theater party for the ladies on April 13, an automobile ride for the ladies and a "rejuvenation" of the Sons of Jove, April 14; an inspection of the Ashley Street station and other properties is scheduled for April 15, and a theater party for the same night.

Meeting of Brooklyn Company Section.—The April meeting of the Brooklyn Company Section of the National Electric Light Association was held on Monday, April 3. The program included a paper by Mr. W. C. Pike on "Practical Accounting," which was of great interest and thoroughly discussed by members of all departments. Following the paper an interesting talk on "The Development of the Motor Car" from its beginnings in 1600 to 1896, when it commenced to assume its present-day form, was given by Mr. Parker H. Kemble, editor of the section *Bulletin*. The talk was illustrated by lantern slides made from old prints and engravings and presented to the section a side of the motor car concerning which comparatively little is known. Mr. E. E. Higgins, of the Anderson Company, then gave a thorough exposition of "The Modern Electric Vehicle," using the stereopticon to illustrate the various points of construction and operation. Besides these papers and addresses, the program for the evening included motion-picture films, illustrated songs, a vaudeville entertainment and refreshments and music. The attendance was between 400 and 500. This was the last of the section meetings of the season and the members will not meet again until the convention on June 31, which will be held at the Oriental Hotel, Coney Island.

WATER-POWER DEVELOPMENT IN SOUTHERN MINNESOTA.

The Blue Earth Hydroelectric Plant of the Consumers' Power Company, Serving Mankato and Vicinity.

THE new Blue Earth water-power development of the Consumers' Power Company on the Blue Earth River nine miles southwest of the City of Mankato, Minn., to which it transmits energy, is planned for a future 3500-hp development, of which 2320 hp in waterwheel-driven generating machinery is already installed and in operation. The dam, which creates a normal operating head of 62.5 ft., is of the hollow, reinforced-concrete type and carries on vertical extensions of its buttresses a 16-ft. county roadway 70 ft. above the tail-water surface, as shown in Fig. 1. The hydroelectric energy developed at the Rapidan plant is transmitted at 33,000 volts to the Mankato substation, where it is reduced and converted into suitable forms for supplying the city lighting and power service and for operating the street railway. Later this transmission line will be extended to Faribault, joining there the similar transmission through Northfield from the Cannon Falls water-power plant of the same company. The line will thus link together these two hydroelectric developments eighty miles apart, supplying through transformer substations the whole adjacent region with electrical service.

DAM AND HYDRAULIC WORKS.

The Blue Earth plant develops a former rapids and falls in the Blue Earth River near the center of Blue Earth County, Minnesota, and two miles west of the village of Rapidan. With its crests 53.5 ft. above tailwater and surmounted by 8-ft. tainter gates, the Ambursen hollow, reinforced-concrete dam impounds backwater for nearly six miles along the old river valley, creating a pond surface of about 550 acres. By drawing down the pond area thus formed to a depth of 15 ft., enough water can be obtained to operate the plant about twenty days if necessary. The turbines are designed to operate efficiently throughout this range of 47 ft. to 62.5 ft. of head.

The task of providing for the flowage of the impounded water also included the removal of a county bridge near the dam site, the deck of which would have been submerged about 28 ft. by the pond created. This crossing is replaced by the concrete roadway carried on the dam buttresses seen in Fig. 1, the steel bridge itself being moved to a point four miles up stream, where it provides another crossing for neighboring residents.

The dam, including the power-house section, is 500 ft. long, of which 272 ft. is spillway. There are fifteen bays or cells, separated by concrete buttresses 24 in. thick, and having up-and-down-stream bases 159 ft. long. On these buttresses is supported the 45-deg. sloping upstream wall or deck, the weight of the water itself pressing downward on this surface and rendering the structure stable against overturning or sliding caused by horizontal thrust. The cut-off wall at the level of the dam is carried down 15 ft. into the sandstone.

Fig. 1—Blue Earth Dam and Power House, Near Mankato, Minn.

The crest of the spillway is at an elevation of 151 ft. above datum, tailwater being at 96 ft. The seven 32-ft. hand-operated tainter gates stand 7 ft. above the spillway crest. To the tops of these gates are fixed 12-in. flashboards, the pins of which are designed to break, dropping the boards when more than 8 in. of water flows over their tops. The tainter gates are operated from hand-wheel shafts and chain drums. From the spillways the concrete aprons are carried downward with a gentle reverse curve designed to discharge the water without vertical impact into the splash pool below. Beneath the east end of the spillway apron are four 7-ft. x 5-ft. sluice gates closed by hand-operated worm gear from platforms within the hollow cells of the dam, which is penetrated by two gallery passages extending throughout its length. Together with the spillway the four sluice gates have a capacity for discharging 30,000 cu. ft. of water per second in case of flood, or about one-seventh of the water that goes over Niagara Falls. On top of the piers, which also serve to support the pivots of the tainter gates, is carried the 16-ft. county-road crossing at a level with the adjacent plain and approach. The road structure is of reinforced concrete, its 36-ft. spans resting on 18-in. x 24-in. concrete beams.

Fig. 2—Interior of Power House.

Ground was broken for the Rapidan dam on March 15, 1910, and the wheels were started up Feb. 25, 1911. During this interval 21,800 cu. yd. of rock excavation and 7100 cu. yd. of earth excavation were removed, and 20,000 cu. yd. of reinforced concrete was poured in the forms of the dam.

POWER HOUSE.

The power-house structure, which forms part of the dam bulkhead, is a poured-concrete building, 73 ft. long and 38 ft. wide, with a height of 30 ft. to the steel trusses supporting the tile roof. Two 1160-hp waterwheel-driven generator sets and one waterwheel-driven exciter set are already installed in the station, which is designed to contain additionally one main alternator set and one exciter set. An interior view of the power house is shown in Fig. 2.

Fig. 3—Switchboard at Power House.

The water entering the headgates to the hydraulic units is

cleared of any rubbish by a floating boom extending across the power-house corner of the floor bay. There are also inclined steel trash racks, arranged in two panels to slide in the channels of parallel I-beams like window sash so that either section can be pulled up for cleaning. The converging walls of square-sectioned concrete boxes convey the water from the hand-operated headgates to 5-ft. cast-iron thimbles in the concrete bulkhead wall of the power house, from which are led the riveted-steel penstock tubes to the waterwheels.

Each of the present main alternator units consists of a twin pair of horizontal 32-in. spiral-case Pelton-Francis water turbines direct-connected to drive a 750-kw, 2300-volt, 60-cycle, three-phase General Electric generator at 300 r.p.m. Individual 16-kw direct-current exciter units are mounted on extensions of the main shafts of these machines. Between the waterwheels and the main generator of each unit is mounted a 12,000-lb. flywheel to assist regulation of the machines. The units are controlled by Pelton oil-pressure governors, operating rocker arms which manipulate the gates of the twin waterwheels simultaneously. In addition to the direct-connected ining the effects of the trolley peaks of demand of the Mankato street-car system to a minimum voltage variation at the generator buses.

For raising the 2300-volt generated potential to the transmission pressure, 33,000 volts, two 1250-kw, three-phase, oil-insulated, water-cooled transformers are installed in separate concrete compartments closed by roller steel doors. These doors, as shown in Fig. 4, are arranged with fusible links and drop automatically in case of abnormal rise of temperature or fire in the compartments. From the high-tension terminals of the transformers the 33,000-volt buses rise through ceiling-type insulators to the disconnecting switches, separated by 3-in. concrete barriers, on the floor above. These switches enable either or both transformers to be connected to the horizontal overhead buses which pass through the east wall of the chamber to the solenoid-operated General Electric high-tension line oil switch in the adjoining concrete switchroom. All of the high-tension buses are of ¾-in. copper tubing, 1/16 in. thick, all joints being sweated connections. The high-tension line switch, Fig. 5, is equipped with trip coils in each lead and is arranged

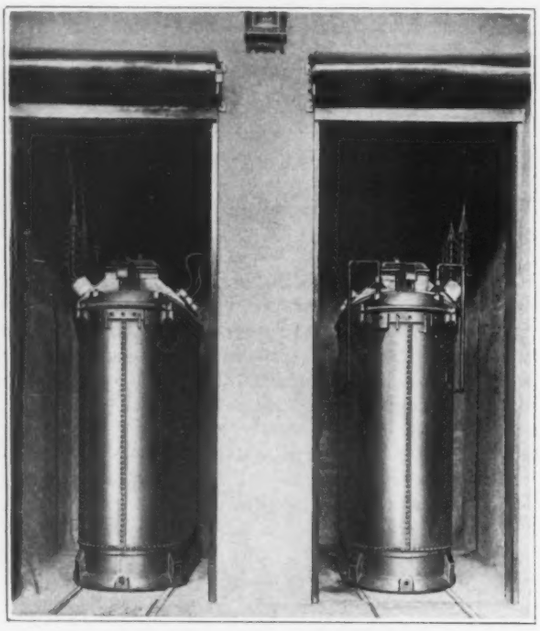


Fig. 4—Transformer Compartments with Self-Closing Doors.

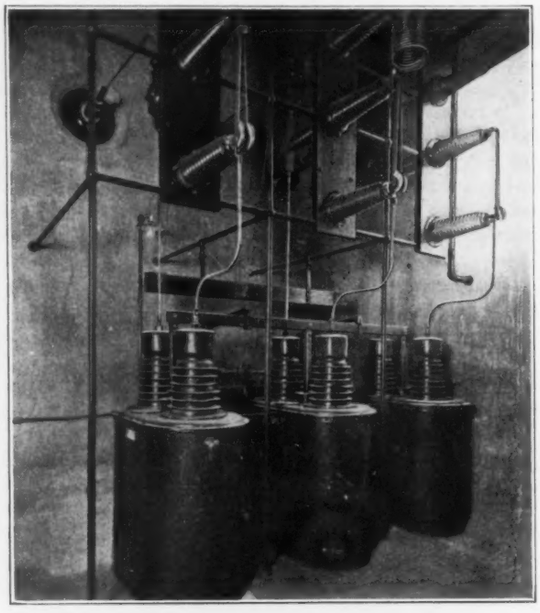


Fig. 5—High-Tension Oil Switch to Transmission Line.

dividual exciter units there is also a separate 50-kw exciter driven by an 80-hp waterwheel fed through an inverted siphon 22-in. supply pipe hung under the floor by U-hooks. All of the waterwheels discharge into steel draft tubes, 16 ft. in length.

SWITCHBOARD.

The main remote-control switchboard, Fig. 3, is installed in an opening under the north curtain wall of the waterwheel-room. Directly behind the board is a two-story switch bay, on the second floor of which all of the 2300-volt oil switches are mounted, being manipulated by pull rods from the handles on the switchboard below. With the exception of the instrument transformers on the 2300-volt cables, which ascend on the wall behind the first-story switchboard passage, no potential higher than the exciter voltage is exposed on the lower floor level. The 2300-volt oil switches above are mounted between 2-in. concrete barriers, with Hyrib centers. The main 2300-volt buses are carried on insulators across the tops of these panels, being sectionalized by the insertion of current transformers between the machine and transformer switches so that the output of the plant can be measured by the totalizing watt-hour meter in front. The black-slate switchboard comprises the two present and one future alternator panel, the exciter panels, regulator panel, transformer panels and station lighting and power panels. A Tirrill regulator is installed and is effective in reducto open with an inverse time element. From the line switch the buses pass through the high-tension exits in the north wall of the building, where they are connected to the No. 3 copper line conductors. From this point the lightning-arrester discharge paths are tapped off, passing through the horn-gaps mounted on the power-house roof, shown in Fig. 6, and into the end chamber of the high-tension gallery, where the aluminum-cell arresters are installed. Each phase wire is thus tapped through an arrester cell to a common point which is grounded through a fourth cell to ground. A single aluminum-cell gap inserted in the ground wire of the arresters is bridged by an alarm bell which indicates when the arresters are discharging.

TRANSMISSION LINE.

The transmission line from the Rapidan dam into Mankato employs the unique improved type of "wishbone" cross-arm construction developed by the engineering department of H. M. Byllesby & Company and described in the *Electrical World* Dec. 1, 1910. Two pieces of steel angle section are bent as shown in Fig. 7, and bolted together in the V-shape illustrated. This is then pinned to the pole at points two-thirds of the distance from the crotch end, at which the single insulator pin is attached, an arm of the V passing on each side of the pole. The two wires on one side, at a distance from the pole half that of the third one on the single-wire side, thus balance the arms for both horizontal and vertical forces. The arms are mutually braced between themselves, and tendency to rotate

about the pole is prevented by the manner in which the arms are through-bolted on each side of the pole. The inclined position of the top cross-arm permits the top line wire to be carried above the pole top, allowing the use of shorter poles. When running along highways tree trimming can be reduced by placing the long side of the arms over the roadway. As the wires are at different heights, they are prevented from swinging together in high winds. No gains are needed in mounting the arms.

The Rapidan-Mankato line, 11.25 miles in length, consists of three No. 3 hard-drawn copper wires carried on Thomas insulators at the apexes of a 6-ft. triangle. A ground wire of ¼-in. Siemens-Marting steel strand is carried on angle-iron bayonets pinned under the cross-arm through-bolts and grounded at every pole. The 35-ft. wooden poles are placed at 150-ft. intervals.

Six feet below the transmission wires, on the same poles, is carried a telephone circuit on standard cross-arm construction. At both the power-house and substation ends the instruments are protected by highly insulated repeating coils and the line is cleared of induction troubles by attaching retard coils.

MANKATO SUBSTATION.

The Mankato transforming substation has been constructed as an addition to the existing gas-engine and steam-driven generating plant which formerly supplied the city lighting and railway service. Part of this prime-mover equipment will be retained for auxiliary purposes in connection with the hydro-electric transmission.

At the city end the incoming transmission circuit is equipped with aluminum-cell lightning arresters, oil switch and disconnecting switches leading to four 400-kva oil-insulated transformers, one of which is arranged as a spare unit. These transformers are inclosed in separate concrete cells and tubular buses are used as in the water-power station. All 2300-volt switches and circuits are installed on a second-floor gallery, Fig. 8, above the switchboard level, no potential higher than that of the 550-volt trolley circuits appearing on the board. A 200-kw synchronous motor-generator set has been installed for converting the incoming alternating-current energy into direct current for the street railway, replacing the 200-kw Corliss engine-driven set before used. Another Corliss engine is also held in reserve for belting to a rewound 350-kw, three-phase alternator. The plant also contains two 125-hp and one 85-hp Westinghouse vertical three-cylinder gas engine, driving a jackshaft to which a 100-kw alternator is belted. These gas engines were formerly operated on retort coal gas from the illuminating-gas plant which is owned by the same company.

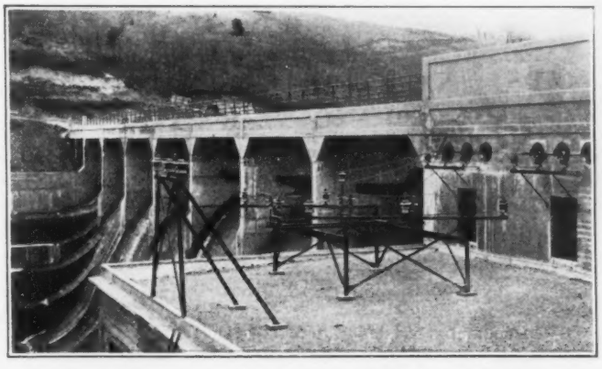


Fig. 6—Horn Gaps and Line and Arrester High-Tension Entries.

Electrical energy for lighting, power and street-railway operation is now supplied through the Mankato substation from the Rapidan water-power. The far end of the Mankato substation has been arranged for the future transmission line to come from Faribault and Cannon Falls.

Mankato, together with North Mankato, which is just across the Minnesota River, is a hustling manufacturing and distributing city of 15,000 inhabitants, and has a number of factories, besides limestone quarries producing the finest building stone in Minnesota. About 500 hp in motors is now connected to the local electric distribution lines and 1130 central-station customers use electricity for lighting their stores, shops, offices and homes.

A 2300-volt line taken directly from the generator buses of the water-power station also furnishes energy to the village

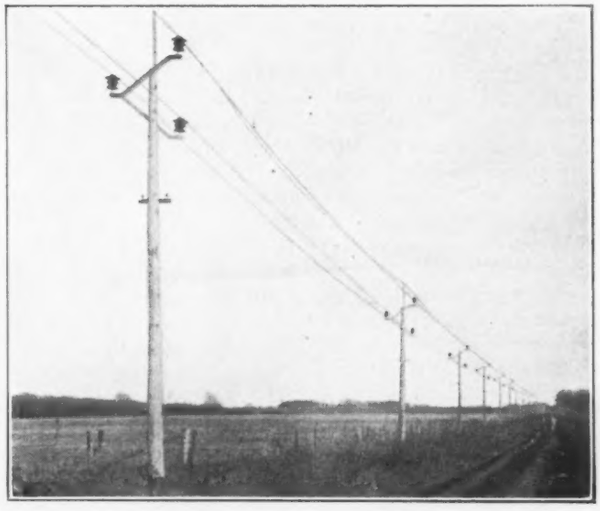


Fig. 7—"Wishbone" Cross-Arm Construction of Transmission Line.

of Rapidan, two miles distant from the dam. The construction of the dams and power houses at Rapidan and Cannon Falls and the substations at Northfield, Faribault and Mankato, together with the reconstruction of the steam reserve stations at the latter points, was done by the engineering department of H. M. Byllesby & Company, Chicago, of which Mr. Otto E. Osthoff is vice-president and chief engineer, Mr. W. R. Thompson, assistant chief engineer, and Mr. J. W. Link, hydraulic engineer. Mr. E. C. Bacot was the designing engineer of the electrical equipment.

The contracts for the dams were carried out by the Ambursen Hydraulic Construction Company, Boston. The Pelton Water Wheel Company furnished the wheels and governors, and the General Electric Company the electrical apparatus.

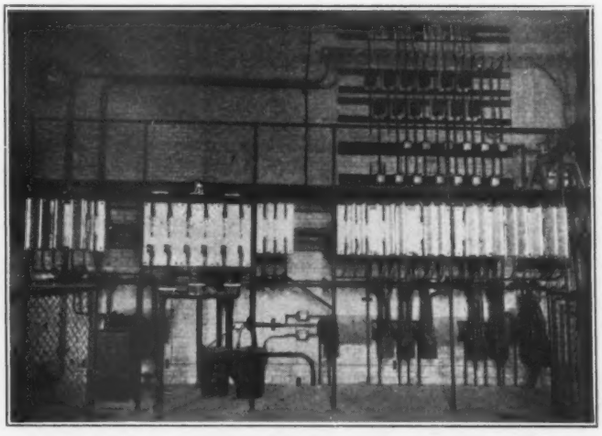


Fig. 8—2300-Volt Construction in Substation at Mankato.

Acting for H. M. Byllesby & Company in the field were Mr. D. M. Bunn, construction superintendent in charge of power house, substations and transmission lines, and Mr. W. B. Sanders, resident engineer at the Blue Earth Dam. The operating department of the Byllesby company is represented by Messrs. R. E. Brown, B. W. Cowperthwaite and J. E. Hanson, managers respectively of the Mankato, Faribault and Northfield divisions of the Consumers' Power Company.

A MECHANICAL ALTERNATING-CURRENT WAVE-ANALYZER.

By C. A. Pierce.

THERE are various methods for determining the harmonic components of periodic alternating e.m.fs. and currents, most of which consist of the analysis of the wave by means of graphical or analytical methods. To obtain the wave various "point-by-point" contact makers are used, or else the wave is photographed by means of an oscillograph. Attempts have been made to measure the component harmonics directly, but the methods advanced for doing this have been deficient in some important particular.

The most accurate method for determining the harmonic components is one in which the wave is obtained by a "point-by-point" contact maker and analyzed by means of tables, the best of which are based upon the complete harmonic analysis of a periodic curve published by Rungi in 1903. The wave can be recorded with an oscillograph, but the accuracy is far less than that of the "point-by-point" contact maker due to the uncertainty in the measurement of the co-ordinates on the photographic record.

One serious defect in nearly all methods for obtaining the harmonic components of periodic alternating waves is that the results are not available until the data are worked up, so that the experiment is carried on in many cases blindly. A method which enables one to see immediately the effect of a change in conditions on any harmonic will facilitate many alternating-current experiments. This result is partially obtained by the oscillograph with a synchronously revolving mirror, which enables an experienced investigator to infer the changes in the harmonic components by the change in the form of the complex wave.

The following method of measuring the component harmonics in a periodic alternating-current wave was developed with the idea of making the measurements of amplitude and phase directly upon the harmonics themselves.

DEVELOPMENT OF THE METHOD.

If a two-part commutator has impressed upon it an alternating e.m.f. and is revolved at synchronous speed, the average value of the e.m.f. may be obtained by a direct-current voltmeter connected to the commutator through two brushes which bear upon it and are separated from each other by 180 deg. The brushes should be shifted about the commutator until the maximum reading of the voltmeter is obtained. This value is a measure of the average value of the impressed wave. The commutator acts as the familiar rectifying device which is employed for many purposes. In the case of a sine wave its action is represented by the equation,

$$D = \frac{E_1'}{\pi}\int_{\alpha}^{\alpha+180}\sin\Theta\, d\Theta = \frac{2E_1'}{\pi}\cos\alpha = E_{1AV.}\cos\alpha,$$

where D is the reading of the voltmeter in volts, E_1' is the maximum ordinate of the sine wave and α relates to the angular position of the brushes. If the brushes are so set that $\alpha = 0$, i.e., if the brushes pass from one segment of the commutator to the other just as the alternating current passes through zero,

$$D = E_{1AV.}.$$

In the case of a complex alternating-current wave,

$$D = \frac{1}{\pi}\left[E_1'\int_{\alpha}^{\alpha+180}\sin\Theta\, d\Theta + E_3'\int_{\alpha}^{\alpha+180}\sin(3\Theta+\Phi_3)\, d\Theta + E_5'\int_{\alpha}^{\alpha+180}\sin(5\Theta+\Phi_5)\, d\Theta + \ldots\right]$$

If $\alpha = 0$,

$$D = [E_{1AV.} + \tfrac{1}{3}E_{3AV.}\cos\Phi_3 + \tfrac{1}{5}E_{5AV.}\cos\Phi_5 + \ldots]$$

The expression in the brackets of the last equation is the expression for the average value of a complex alternating e.m.f. Hence, the two-part commutator will measure the average value of a complex alternating-current wave if the brushes are set so that they pass from one segment to the other at the instant that the alternating current passes through zero. At this position of the brushes the direct-current voltmeter will give the maximum reading.

If a complex alternating current is impressed upon a six-segment synchronously revolving commutator in which the alternate segments are connected electrically together to form a six-part rectifier, a direct-current voltmeter connected to the rectifier through two brushes 60 deg. apart will measure the average value of the third harmonic of the alternating-current wave. It will also measure any harmonic, such as the ninth, fifteenth, etc., which is divisible by three. It will not measure the first harmonic nor any harmonic which is not divisible by three.

The equations for any harmonic impressed upon a six-part commutator are:

$$D = \frac{E_n'}{\pi}\left[\int_{\alpha}^{\alpha+60}\sin(n\Theta+\Phi_n)\, d\Theta - \int_{\alpha+60}^{\alpha+120}\sin(n\Theta+\Phi_n)\, d\Theta + \int_{\alpha+120}^{\alpha+180}\sin(n\Theta+\Phi_n)\, d\Theta\right]$$

$$= \frac{2}{\pi}\times\frac{E_n'}{n}[\cos(n\alpha+\Phi_n)(1-\cos n\times 60+\cos n\times 120) + \sin(n\alpha+\Phi_n)(\sin n\times 60-\sin n\times 120)$$

The second term in the brackets is equal to zero for $n = 1$, 3, 5, 7, etc., i.e., for any odd harmonic; hence,

$$D = \frac{2}{\pi}\times\frac{E_n'}{n}[\cos(n\alpha+\Phi_n)(1-\cos n\times 60+\cos n\times 120)]$$

If $n = 1$, 5, 7, 11, 17, 19, etc.,

$D = 0$.

If $n = 3$,

$$D = \frac{2}{\pi}\times\frac{E_3'}{3}\times 3\cos(3\alpha+\Phi_3)$$

When α and Φ_3 equal zero, i.e., when the brushes are set for the maximum reading of the voltmeter,

$$D = E_{3AV.}.$$

If $n = 9$,

$$D = \frac{2}{\pi}\times\frac{E_9'}{9}\times 3\cos(9\alpha+\Phi_9) = \tfrac{1}{3}E_{9AV.}\cos(9\alpha+\Theta_9),$$

i.e., the reading of the voltmeter will depend upon the setting of the brushes and upon the phase relation of the ninth harmonic. Likewise, any harmonic, such as the fifteenth, twenty-first, etc., will give a reading upon the six-part commutator, but the reading will not equal the average value of the harmonic, being reduced by the factor $\frac{3}{n}$ and also by the factor $\cos(n\alpha+\Phi_n)$.

In a like manner it can be shown that the ten-part commutator will measure the average of the fifth harmonic. Any harmonic which is divisible by five will give a reading upon the ten-part commutator, but the reading will be less than the average value of the harmonic, being reduced by the factor $\frac{5}{n}$ and also by a cosine term which depends upon the position of the brushes and upon the phase position of the harmonic. Furthermore, the fourteen-part commutator will measure the average of the seventh harmonic, etc.

THE WAVE-ANALYZER.

A set of commutators having two, six, ten, fourteen and eighteen segments was mounted on a shaft carried in lignum-vitæ bearings so that it could be rotated rapidly. On each commutator alternate segments were connected electrically so that it formed a rectifier. The commutators were connected in parallel to a pair of slip-rings to which the current to be analyzed was introduced through brushes. A brush holder in the form of a squirrel-cage was arranged to revolve upon bearings which were coaxial with the shaft of the commutators. Upon this squirrel-cage were mounted brushes, each commutator having two brushes placed 180 (or some odd multiple of 180) electrical degrees apart. A direct-current voltmeter was connected to the brushes by means of flexible leads

with clamp-ends which could be changed easily to the different pairs of brushes. Upon one end of the squirrel-cage was described a circle graduated in degrees so as to measure the angular position of the brushes.

To test the wave-analyzer its shaft was lined up with the shaft of a two-pole alternator and the two shafts were connected together mechanically. Various wave-forms were developed in the alternator by varying the field excitation and by loading. An auto-transformer with which the e.m.f. could be changed by volt steps was used to vary the e.m.f. impressed upon the wave-analyzer. Readings were obtained by connecting the voltmeter to the brushes on the various commutators, on each commutator reading the maximum voltage and the corresponding angular position of the brushes. The commutators were set on the shaft so that all angular readings could be made on one scale having but one zero point.

CALCULATION OF THE HARMONICS FROM THE READINGS.

The two readings on each commutator consist of an average e.m.f. and a phase angle. On the two-part commutator the average value of the complex e.m.f. is obtained together with the angular position of the zero points of the wave. The readings on the six-part commutator give the average value of the third harmonic and the zero point together with corrections depending upon the value and phase of higher harmonics, such as the ninth, fifteenth, etc. Corresponding values for the fifth, seventh and ninth harmonics can be obtained on the other commutators.

Neglecting harmonics higher than the ninth, and neglecting the effect of the ninth harmonic on the six-part commutator,

$$E_1 = \sqrt{(1.111 \times E_{AV.})^2 - (1.111 \times E_{3AV.})^2 - (1.111 \times E_{5AV.})^2 - \ldots}$$

where $E_{AV.}$ is the reading on the two-part commutator,* $E_{3AV.}$ that on the six-part commutator, etc. From E_1, $E_{3AV.}$, etc., E_1', E_3', etc., can be obtained by the relations $E_1' = \frac{E_1}{0.707}$ and $E_3' = \frac{E_{3\,AV.}}{0.637}$, etc.

Referring to Fig. 1 it will be seen that the crossings A, B and C of the complex wave and the third and fifth harmonics (together with D and E, which refer to the seventh and ninth harmonics and are not shown in the figure) were determined by the measurements of the angular position of the brushes on the several commutators. A is the from negative to positive zero of the complex wave, B is the first from negative to positive zero of the third harmonic occurring after A. If some other zero of the third harmonic was measured, B can be obtained by adding to, or subtracting from, the angle measured the proper part of 360 deg. C, D and E are the corresponding zeros for the other harmonics.

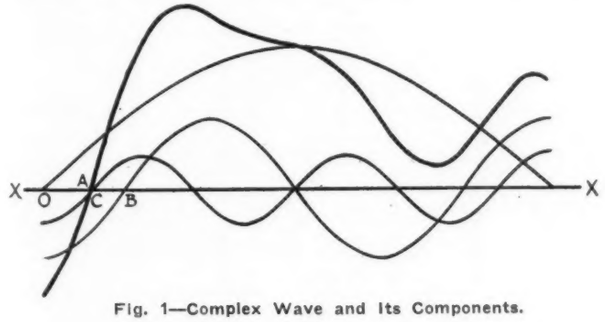


Fig. 1—Complex Wave and Its Components.

Let $\delta_3 = AB$ in Fig. 1, $\delta_5 = AC$, $\delta_7 = AD$ and $\delta_9 = AE$. Also let $\frac{\phi_3}{3} = OB$, $\frac{\phi_5}{5} = OC$, etc., i.e., these are the phase relations of the various harmonics with respect to the first harmonic when the equation of the complex curve is written in the form,

$$E = E_1' \sin\theta + E_3' \sin(3\theta - \Phi_3) + E_5' \sin(5\theta - \Phi_5) + \ldots$$

Some value of θ, OA in the figure, will make $E = 0$. Now,

$$OA = OB - AB = \frac{\Phi_3}{3} - \delta_3,$$
$$= OC - AC = \frac{\Theta_5}{5} - \delta_5,$$
$$= \ldots\ldots = \frac{\Phi_7}{7} - \delta_7,$$
$$= \ldots\ldots\ldots\ldots$$

Hence,

$$E = 0 = E_1' \sin\left(\frac{\Phi_3}{3} - \delta_3\right) + E_3' \sin\left[3\left(\frac{\Phi_3}{3} - \delta_3\right) - \Phi_3\right] + E_5' \sin\left[5\left(\frac{\Phi_5}{5} - \delta_5\right) - \Phi_5\right] + \ldots$$

Or,

$$E_1' \sin\left(\frac{\Phi_3}{3} - \delta_3\right) = E_3' \sin 3\delta_3 + E_5' \sin 5\delta_5 + \ldots\ldots$$

From this equation $\frac{\Phi_3}{3}$ can be determined in terms of the maximum values of the harmonic e.m.fs. and the measured values, δ_3, δ_5, etc. Since $OA = \frac{\Phi_3}{3} - \delta_3$

$$\frac{\Phi_5}{5} = OA + \delta_5,$$
$$\frac{\Phi_7}{7} = OA + \delta_7$$
$$\ldots\ldots\ldots\ldots$$

The equation of the complex curve can now be written.

$$E = E_1' \sin\theta + E_3' \sin 3\left(\theta - \frac{\Phi_3}{3}\right) + E_5' \sin 5\left(\theta - \frac{\Phi_5}{5}\right) + \ldots$$

in which all the values are known.

EXAMPLE OF A WAVE-FORM DETERMINATION.

	Values Measured.		Values Used in Computations.	
	I.	II.	III.	IV.
2.....	71.7 volts	152.0 deg.	152.0 deg.	
6.....	10.0 "	112.5 deg.	232.5 deg.	80.5 deg. $= \delta_3$
10.....	1.7 "	185.7 deg.	185.7 deg.	33.7 deg. $= \delta_5$
14.....	0 "	0	0	0 $= \delta_7$
18.....	0 "	0	0	0 $= \delta_9$

Column I is the voltage readings on the various commutators and column II is the angular positions at which the voltage readings occurred; 2, 6, 10, etc., refer to the two-part commutator, six-part commutator, etc.

$$E_1' = \frac{1}{0.707\sqrt{(1.111 \times 71.7)^2 - (1.111 \times 10.0)^2 - (1.111 \times 1.7)^2}} = 111.5$$

$$E_3' = \frac{10.0}{0.637} = 15.7; \quad E_5' = \frac{1.7}{0.637} = 2.7$$

$$\frac{\Phi_3}{3} = \sin^{-1}\frac{15.7 \sin 241.5 + 2.7 \sin 168.5}{111.5} + 80.5 = 73.7 \text{ deg.}$$

$$\frac{\Phi_5}{5} = 73.7 - 80.5 + 33.7 = -6.8 + 33.7 = 26.9 \text{ deg.}$$

$$E = 111.5 \sin\theta + 15.7 \sin 3(\theta - 73.7 \text{ deg.}) + 2.7 \sin 5(\theta - 26.9 \text{ deg.})$$

DETERMINATION OF THE WAVE-FORM OF ALTERNATING CURRENTS.

To determine the wave-form of an alternating current it is necessary to introduce a non-inductive resistance of suitable value into the circuit, in which case the wave-form of the e.m.f. across the resistance is identical with the wave-form of the current. In many cases a resistance can be placed perma-

*Form factor is, by definition, equal to effective value divided by average value, hence $1.111 \times E_{AV.}$ is not strictly correct. For many waves, the approximation is sufficiently close, but where it is not, the true form factor can be measured as described in a later paragraph.

nently in circuit and considered a part of the circuit. In some cases, however, it is not permissible to introduce very much resistance into a circuit because it will cause a change in the wave-form. In such cases the potential across the resistance must be kept low in comparison with the e.m.f. of the whole circuit. In order to analyze this low e.m.f. on the wave-analyzer some of the resistance in the voltmeter must be cut out in order to make it more sensitive. If so great a reduction of the voltmeter resistance is necessary that the brush contacts produce variations in the readings, a modern-type

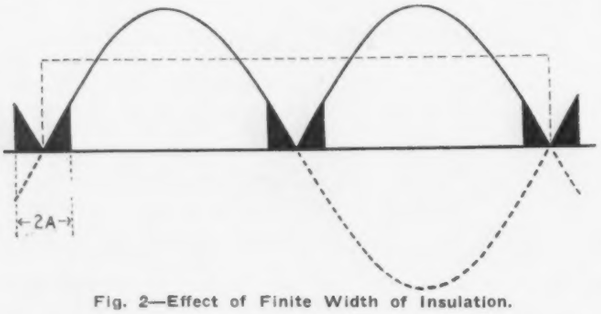


Fig. 2—Effect of Finite Width of Insulation.

D'Arsonval galvanometer of low sensibility can be used in place of the voltmeter.

The equation

$$I = 1.94 \sin \Theta + 0.90 \sin 3\,(\Theta - 67 \text{ deg.}) + 0.07 \sin 5\,(\Theta - 11 \text{ deg.})$$

was obtained with the wave-analyzer. It represents the exciting current of a 60-cycle, 110-volt transformer when 77 volts from a particular alternator run at 25 cycles was applied to the terminals. To measure the wave-form of the current a 0.1-ohm non-inductive resistance was connected in series with the transformer coil, giving an e.m.f. of 0.2 volt to be analyzed. A D'Arsonval galvanometer of very low sensibility was used as the indicating instrument on the wave-analyzer for the current determination. A lower non-inductive resistance could have been used with a galvanometer of somewhat greater sensibility.

ERRORS AND APPROXIMATION IN THE METHOD.

The equations occurring earlier in the article were based upon the assumptions that the insulation between commutator segments was of zero thickness and that the brushes made contact in a line without area. Fig. 2 shows the error made by neglecting the width $2A$ of the insulation. The area of the rectified wave is reduced, as shown by the shaded portions in the figure, by an amount depending on the width of the insulation.

Fig. 3 shows the error made by the combined effects of width of insulation and width of brush. Since a brush continues to

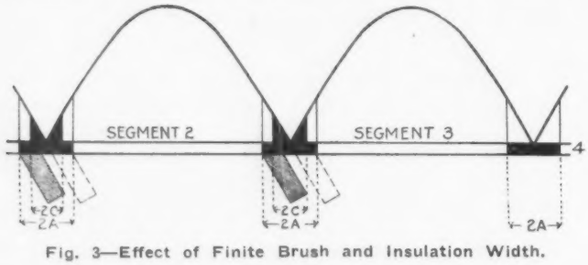


Fig. 3—Effect of Finite Brush and Insulation Width.

make contact after part of it has left a segment, and since the brush-contact resistance is negligible in comparison with the resistance of the direct-current voltmeter, the effect of the length of brush contact is to correct for the error due to width of insulation. Hence, the area lost is that determined by the distance $2A - 2B = 2C$, where $2B$ is the length of contact of brush with commutator. If the brush contacts were just as wide as the insulation no area would be lost, but the segments would be short-circuited every time a brush passed from one segment to the next. In the wave-analyzer described above the brush contact equaled 0.72 deg. and the insulation equaled 1.36 deg. The area lost in the case of a sine wave on the two-part commutator is negligible. The area lost increases as the number of segments on a commutator increases, because the combined width of brush and insulation is larger in comparison with a segment. The area lost in a half wave in the case of the eighteen-part commutator is

$$2\int_0^{n \times 0.32 \text{ deg.}} \sin \Theta \, d\Theta = 2\int_0^{2.9 \text{ deg.}} \sin \Theta \, d\Theta = 0.003 \text{ approximately,}$$

which is negligible in comparison with the area of a half wave. In the case of a complex wave on the two-part commutator, the error may be, in certain cases, larger than with a sine wave. No serious error will be introduced, however, with the wave-forms usually found in practice.

As was shown, no reading is produced on the six-part commutator by the first harmonic if the width of brush and insulation is zero. The effect of combined width of brush and insulation is shown in Fig. 4, where the first harmonic is broken into positive and negative parts due to the rectifier effect. The figure is drawn to represent commutation occurring at 0 deg., 60 deg. and 120 deg. The equation for commutation occurring at any time is

$$E = \frac{E_1'}{\pi}\left[\int_{a+c}^{60+a-c} \sin \Theta \, d\Theta - \int_{60+a+c}^{120+a-c} \sin \Theta \, d\Theta + \int_{120+a+c}^{180+a-c} \sin \Theta \, d\Theta\right] = 0.$$

Hence, the first harmonic can produce no reading on the six-part commutator. Similar equations for the other commutators would give similar results; and, furthermore, it can be shown that no error is produced in the measurement of any harmonic by lower harmonics.

As was proved, the ninth harmonic can produce a reading on the six-part commutator. The effect of width of brush and insulation on this error is negligible. Hence, as was proved, the error will be equal to one-third of the average value of the ninth harmonic multiplied by a cosine term. Since the ninth harmonic is usually only a small percentage of the third, no serious error will be produced.

The error in determining the maximum value of the first harmonic due to neglect of harmonics of higher order than the ninth is negligible for all ordinary cases because any harmonic of small amplitude produces but little error in the equation given.

To determine whether any harmonic greater than the ninth is present in a wave an alternating-current voltmeter may be connected in parallel with the direct-current voltmeter and the

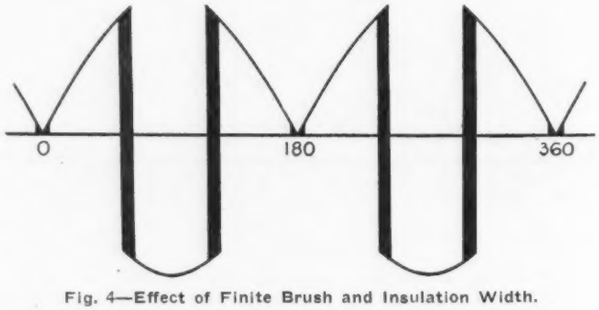


Fig. 4—Effect of Finite Brush and Insulation Width.

two placed on the brushes of the two-part commutator. If the brushes are revolved until the voltmeters give the maximum readings,

$$\text{form factor} = \frac{\text{alternating-current voltmeter reading}}{\text{direct-current voltmeter reading}}$$

This value can be compared with the value determined by the amplitudes and phases of the harmonics:

$$\text{form factor} = \frac{\sqrt{(E_1)^2 + (E_3)^2 + (E_5)^2 + \ldots}}{E_{1AV.} + \frac{1}{3}E_{3AV.}\cos \Phi_3 + \frac{1}{5}E_{5AV.}\cos \Phi_5 + \ldots}$$

It must be remembered that the alternating-current voltmeter measures a rectified alternating current, so that errors may be introduced due to stray fields. Taking the average value of two readings with the current reversed and not reversed will eliminate this error.

If the brushes do not revolve around the same axis as the commutators an error may be introduced into any harmonic due to the lower harmonics. For instance, on the six-part commutator the sum of the rectified parts of the first harmonic may not equal zero under these conditions. Such an error can be recognized by the difference in the readings obtained at angular settings of the brushes differing by 180 electrical degrees or 360 electrical degrees. In the first rough machine made a slight error was noticeable in the third harmonic. In the machine as reconstructed no errors were found except in the seventh and ninth harmonics. Considering that the writer made both machines it is to be assumed that no trouble would be found in a machine made by a good mechanic. This error can be eliminated, when not too large, by taking the average of two neighboring determinations.

In accuracy the wave-analyzer stands between the "point-by-point" methods at their best and the oscillograph. In any case, except under ideal laboratory conditions, the accuracy of the wave-analyzer should equal or exceed that of the "point-by-point" methods due in part to the necessity of holding conditions constant for only five voltage readings; the angle determinations do not need such constant conditions.

Another advantage of the wave-analyzer over some "point-by-point" contact makers is that it is not a delicate piece of apparatus, no delays are caused by insulation troubles and the direct-current voltmeter is a reliable and rugged instrument.

A further advantage of the wave-analyzer over other methods is that amplitude and phase measurements are made directly upon the harmonics themselves. Suppose that the error in the determination of a third harmonic is 10 per cent and that the third harmonic is 20 per cent of the first. The error of the third harmonic in terms of the first is, then, 2 per cent. Any method which gives the harmonics by analysis of a complex wave must be such as to give the points on the complex wave with great exactness in order to secure moderate accu-

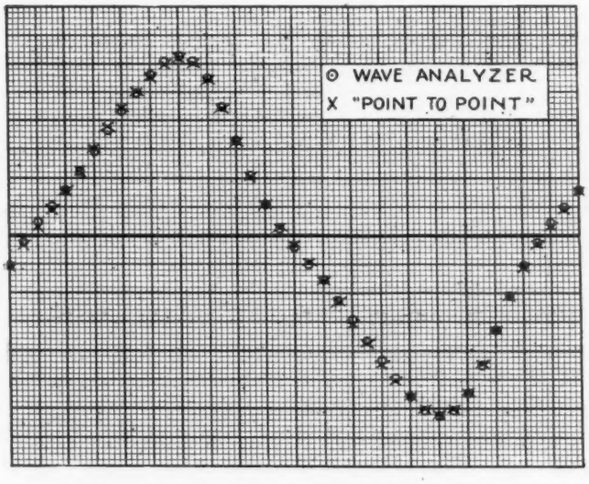


Fig. 5—Waves Obtained by Analyzer and by Point-by-Point Method.

racy in the value of the harmonics. This is well brought out by the equations:

$$E = 111.5 \sin \theta + 15.7 \sin 3\ (\theta - 74 \text{ deg.}) + 2.7 \sin 5\ (\theta - 27 \text{ deg.})$$

$$E = 111.5 \sin \theta + 13.7 \sin 3\ (\theta - 73 \text{ deg.}) + 3.4 \sin 5\ (\theta - 26 \text{ deg.})$$

The first is that as determined by the wave-analyzer and the second that by a "point-by-point" method which was somewhat inaccurate. The runs from which the two equations were made were as nearly identical as could be obtained with the apparatus and assistance available. Fig. 5 shows the plots of the two equations. No such impression of inaccuracy is obtained from inspection of the curves as is obtained by comparing the amplitudes of the harmonics in the equations.

In order to compare the wave-analyzer with the oscillograph an oscillograph record of a wave was made by means of a falling plate. No correction was made to eliminate the distortion due to acceleration of gravity. Fig. 6 shows the oscillograph record, which was obtained under the conditions of Fig. 5.

OPERATION AT 60 CYCLES.

A two-part commutator has to be driven at a speed of 3600

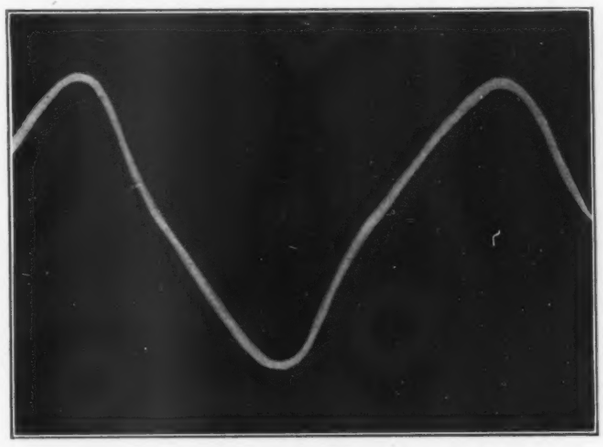


Fig. 6—Oscillogram of Wave Shown by Fig. 5.

r.p.m. in order to rectify 60-cycle alternating current. To use the wave-analyzer on 60-cycle current it would be necessary to drive it by means of a two-pole synchronous motor or else by means of gearing. The wave-analyzer has not been run at a speed as high as this because no driving motor nor accurate gearing was available. However, in order to test whether the commutator and brushes would stand this speed a two-part commutator was made and geared up four to one and attached to a machine run at 900 r.p.m. This commutator and the brushes were made of the same materials as the commutators and brushes of the wave-analyzer. The commutator was made with phosphor-bronze segments mounted on fiber and fiber was used as insulation between the segments. The brushes were made by cutting down ordinary carbon brushes. This commutator was run for some time and was found to work satisfactorily. The best lubricant for the commutator was found to be kerosene. This softened the brushes so that all wear came on them, preserving the commutator surface. Of course, the brushes wore out rapidly, but these were easily renewed. The use of kerosene avoided any gumming of the commutators and brushes, which is very desirable in this work.

PRESSURE RISES ON OPENING SHORT-CIRCUITS.

A PAPER of much interest to manufacturers and users of high-tension and low-tension switchgear was read by Mr. A. G. Collis before the South Wales Institute of Engineers at Cardiff, Wales, on Feb. 23, 1911. The author selected representative samples of various types of circuit-breakers in general use, and made comparative tests under conditions approximating to those likely to be encountered in practice. An oscillograph was used in connection with a rapidly moving photographic film and a large number of records showing the current and pressure variations over the short period of time required by the automatic switches to open the circuit were reproduced in the paper.

Some of the most interesting records are those illustrating the behavior of various types of circuit-breaker on short-circuit. These tests were made on both a direct-current gen-

erator and a storage battery. The arrangement of the plant and connections is shown in Figs. 1 and 4. The generator *G* used for the first series of tests was steam-driven and rated for a normal output of 100 kw at 230 volts. The battery, shown in Fig. 4, consisted of 110 cells in series and was rated for a maximum discharge of 353 amp under normal working conditions. The tests were made by closing first one and then the other of the two single-pole switches shown in the diagrams.

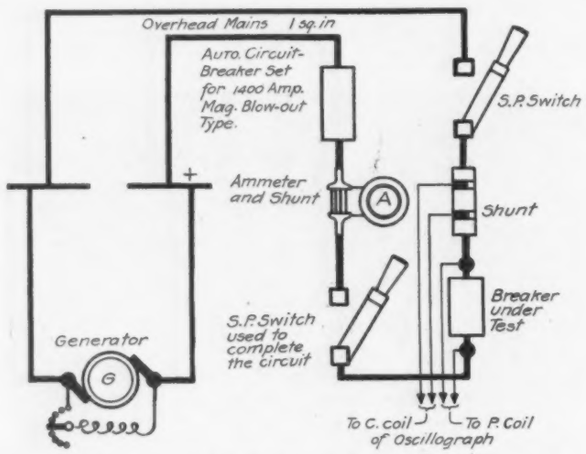


Fig. 1—Short-Circuit Test on Direct-Current Generator.

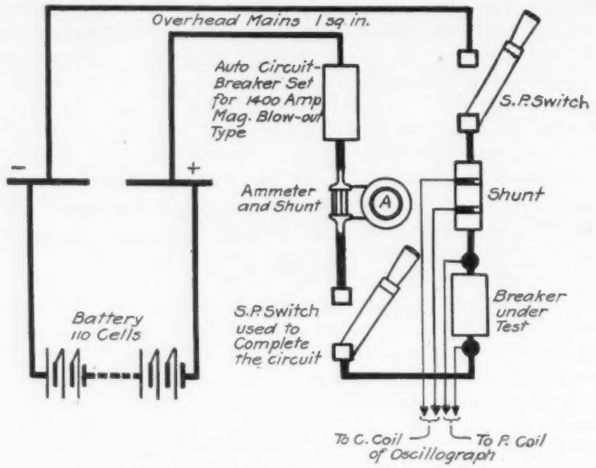


Fig. 4—Short-Circuit Test on Battery.

The short-circuit thus produced was then interrupted by the automatic circuit-breaker under test. It will be seen from the diagrams that the potential coil of the oscillograph was connected directly across the terminals of the apparatus under test, while the current coil, being connected across a resistance in series with the circuit-breaker, measured the total current passing through the main circuit from the moment the second of the single-pole switches was closed to the moment when the current was again finally interrupted by the automatic breaker under test.

SHORT-CIRCUIT TESTS ON GENERATOR.

The oscillogram of Fig. 2 shows the effect of closing the generator on a circuit-breaker fitted with a long, quick break and auxiliary carbon contacts, but without magnetic blow-out. The photographic film in this and subsequent diagrams must be considered as moving from left to right; that is to say, any vertical measurement of current or potential values made on the *left-hand* side of the diagram refers to an instantaneous condition which has occurred *later in time* than the condition indicated by similar measurements taken on the *right-hand* side of the diagram. If, therefore, the curves be read from right to left it will be seen that when the full pressure of the generator is thrown on to the circuit-breaker the current rises from zero to a maximum of 1100 amp in 0.0346 second, after which, owing to the operation of the automatic circuit-breaker, the current again falls to zero in about the same interval of time (0.0332 second). The instant at which the circuit-breaker begins to open the circuit is indicated by the point at which the pressure curve begins to rise. It will be seen that the e.m.f. across the circuit-breaker terminals reaches a total of 497 volts in 0.0254 second, and, since the normal voltage of the generator was 226, the pressure rise, due to the rapid opening of a circuit having appreciable self-induction, is $497 - 226 = 271$ volts. The inductance of the circuit is, of course, mainly in the generator itself; its presence is indicated in the oscillogram of Fig. 2 not only by the pressure rise at break, but also by the slope of the curve showing the gradual rise of the current in the circuit. If there were absolutely no inductance in the circuit the rise of current would be instantaneous and this point is of interest in connection with the tests made by short-circuiting a battery.

In Fig. 3 the pressure rise is considerably greater, although the constants of the circuit remain practically unaltered. In this case a circuit-breaker with final break in a magnetic field was under test and the greater pressure rise (574 volts) was no doubt mainly due to the fact that the current was interrupted more quickly than in the case of the previous test. On the other hand, the mechanical operation of the tripping mechanism was somewhat slower than in the case of the carbon-break circuit-breaker, and this would account for the current having reached 1300 amp as against the 1100 amp of Fig. 2. Fig. 5 is generally similar to Fig. 3, and both refer to the same circuit-breaker, but in Fig. 5 the arc would appear to have been disrupted and then started again, probably due to mechanical vibrations of the moving arm of the circuit-breaker, which have tended to re-establish the current.

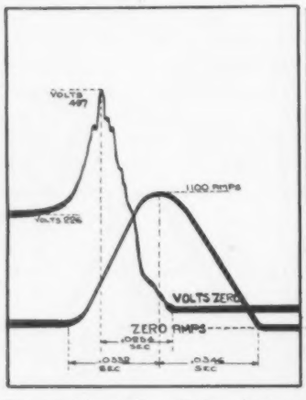


Fig. 2—Short-Circuit Opening on a Carbon-Break Circuit-Breaker.

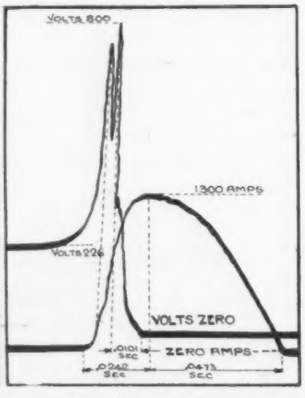


Fig. 3—Short-Circuit Opening on a Medium-Field Magnetic Blow-Out Breaker.

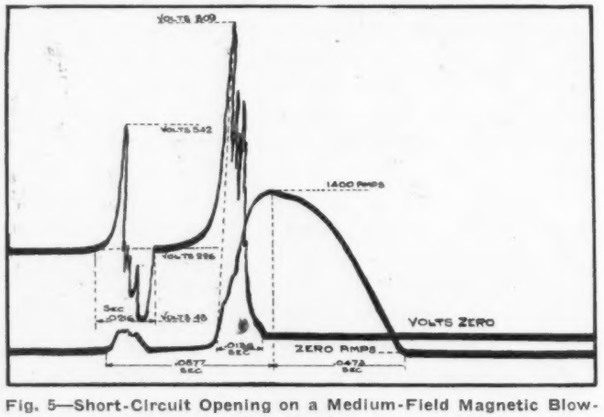


Fig. 5—Short-Circuit Opening on a Medium-Field Magnetic Blow-Out Breaker.

An important feature of Mr. Collis' paper is the information it contains in regard to the use of the oil type of circuit-breaker

in direct-current circuits. Fig. 6 is an oscillogram which shows the behavior of an oil circuit-breaker of the type generally used in alternating-current circuits tested while opening a direct-current short-circuit. This apparatus was tested on the generator exactly in the same manner as the circuit-breakers previously described. The total length of time covering the closing

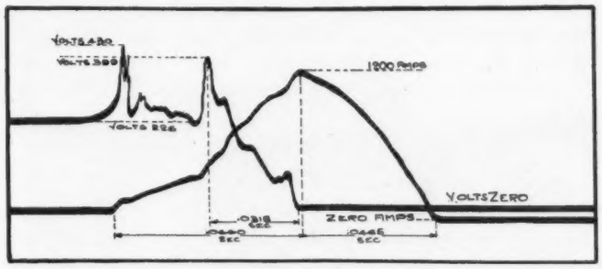


Fig. 6—Short-Circuit Opening on an Oil-Break Switch.

of the circuit and its final interruption occupied a little over one-tenth of a second with a rise in pressure of only 204 volts notwithstanding that the current rose to 1200 amp. The variations in the current due to changes in the resistance of the arc under the oil are reflected by corresponding changes in the pressure curve. It is clear that, so far as any abnormal pressure rise is concerned, the oil type of circuit-breaker compares favorably with the other types tested. The author of the paper states that a fact of some importance, which cannot be shown on the oscillograms, is the silent operation of the oil breakers, which is very noticeable in comparison with the explosive violence with which the magnetic blow-out and other breakers interrupt the circuit.

SHORT-CIRCUIT TESTS ON A BATTERY.

The diagrams of Figs. 7 and 8 show the behavior of the same oil circuit-breaker when a battery instead of a direct-current generator was short-circuited through it. These diagrams are interesting as showing the comparative absence of inductance in the circuit. This absence of inductance is shown by the steep rise of the current curve when the circuit is closed and also by the very small rise of pressure at the final break (only 59 volts in Fig. 7, as against 204 volts in Fig. 6). Another fact which is clearly indicated by these and the following diagrams is that the total current output of the battery, as limited by the resistance of the circuit (including the internal resistance of the battery), was 1200 amp, and this steady and ultimate value of the current was always reached before the circuit was finally interrupted.

Fig. 9 shows the effect of short-circuiting the battery on a circuit-breaker with magnetic blow-out. This oscillogram may be compared with Figs. 3 and 5, which are the records of the same circuit-breaker on a generator short-circuit. The inductive pressure rise, even on the battery test, is considerably greater than in the case of the oil type of circuit-breaker, but

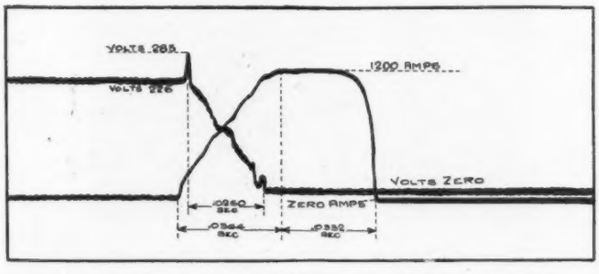


Fig. 7—Short-Circuit Opening on an Oil-Break Switch.

this is no doubt mainly due to the very much more rapid action of the magnetic blow-out breaker. Thus, in Fig. 9 it will be seen that the current falls from the maximum value of 1200 amp to zero in 0.0184 second, whereas in Fig. 8 (oil circuit-breaker) the corresponding time is 0.0473 second.

The diagram of Fig. 10 is one of the most interesting. It shows the effect of opening the battery short-circuit with the carbon-break circuit-breaker without magnetic blow-out field. There would appear to be an entire absence of pressure rise on the final rupture of the circuit.

Apart from the short-circuit tests on direct-current generator and battery, the author of the paper included oscillo-

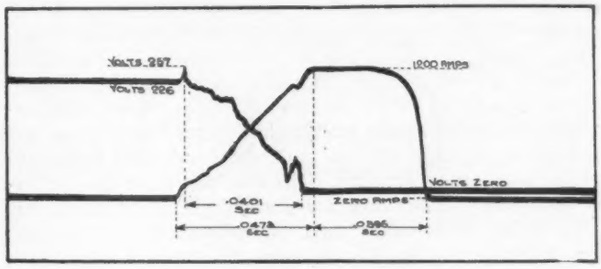


Fig. 8—Short-Circuit Opening on an Oil-Break Switch.

grams referring to a long series of tests of the various types of circuit-breakers at predetermined overloads, not only in direct-current circuits, but also on alternating-current circuits, both low-tension and high-tension. The conclusions which he arrives at, after making a careful study of the results obtained, are as follows:

First—That within the limits of the conditions under which the tests were made the method of opening direct-current circuits by breaking contact under oil is safe and efficient.

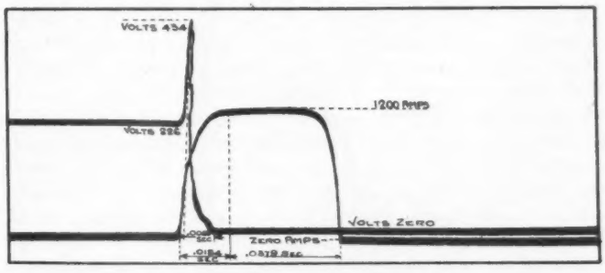


Fig. 9—Short-Circuit Opening on a Medium-Field Magnetic Blow-Out Circuit-Breaker.

Second—That a breaker with a wide break and comparatively weak magnetic blow-out is a safer device to use on all circuits having appreciable inductance than the type with short break accompanied by the necessarily strong blow-out magnetic field.

Third—That a carbon-break circuit-breaker without magnetic blow-out tends to reduce the rise of pressure occurring at rupture of the current.

In the case of the alternating-current tests the oil type of circuit-breaker was used, and the records show that, although the circuit may open at any point on the current curve, after

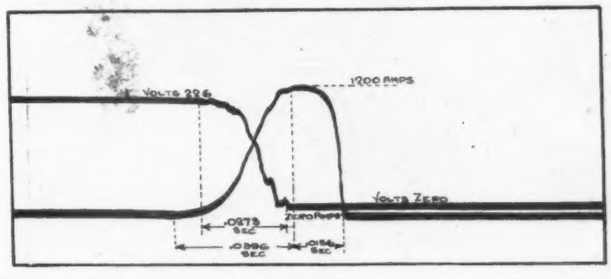


Fig. 10—Short-Circuit Opening on a Carbon-Break Circuit Breaker

the current has died down to zero value it never again rises on the other side of the zero line. It would appear, in fact, that in all cases the oil rushes in between the contacts and prevents an arc being drawn out which otherwise might permit the current to rise once more after it has passed through zero value.

ELECTRIC FIELD SEARCHLANTERNS OF THE UNITED STATES ARMY.

As pointed out by Mr. Earl Wheeler and Lieut. W. H. Rose in the January, 1911, number of the *Professional Memoirs of the Engineers Corps, United States Army,* field electric searchlanterns have important uses in night military operations of both offensive and defensive character. For the aid of the defensive army these lanterns can be used to illuminate points which attacking parties must pass; to light the attacking forces at close range; to illuminate distant areas, embarrassing troop movements and disclosing the transportation of supplies; to impede the use of hostile searchlights by producing glare; to aid working parties of all kinds; to assist in collecting wounded, and for purposes of signaling. The attacking force can use its searchlanterns to advantage for preventing the defense from strengthening works under cover of darkness; to light up artillery targets, redoubts, etc.; to assist the attacking column by illuminating rough ground and obstacles; to guide attacks by lighting defenders' lines under assault; to assist in repelling counter attacks, and for the general uses already mentioned above.

The most recent portable searchlantern outfits in the service of the United States army are the automobile searchlantern truck and the field-artillery set designed by the engineering department. The automobile truck, shown in Fig. 1, is equipped with a 15-kw gasoline-engine-driven generator producing electrical energy to operate the motors at each wheel-axle during transit and to supply the projection apparatus during use. The gasoline-engine generating set comprises a semi-automobile-type, five-cylinder, four-cycle, 5-in. x 6-in. Dock inclosed-type water-cooled engine of special design, direct-connected to drive a 15-kw Sprague six-pole, 85-volt, interpole, compound-wound direct-current generator. The engine is equipped with a fly-ball throttling governor, McCord force-feed lubricator and Stromberg float-feed carburetor. Gasoline is supplied through a sight reservoir from an 87-gal. tank on the car. The interpole construction of the generator enables overloads of 75 per cent to be negotiated without sparking, and the engine rating has been provided to deliver such outputs when the car must pull itself or other objects up steep grades. Inside the steel-plate structure of each of the four wheels is an electric motor, the pinioned shaft of which drives the wheel through annular racks. An eight-point street-car-type controller effects changes in the motor connections from series to parallel, giving any desired speed from three to ten miles an hour, for following bodies in marching order. The motors can be used for electric braking in emergency or long descents, although mechanical brakes are also provided. Four-wheel steering enables the car to make short turns, the hind wheels tracking with those in front and reducing tractive effort through heavy roads.

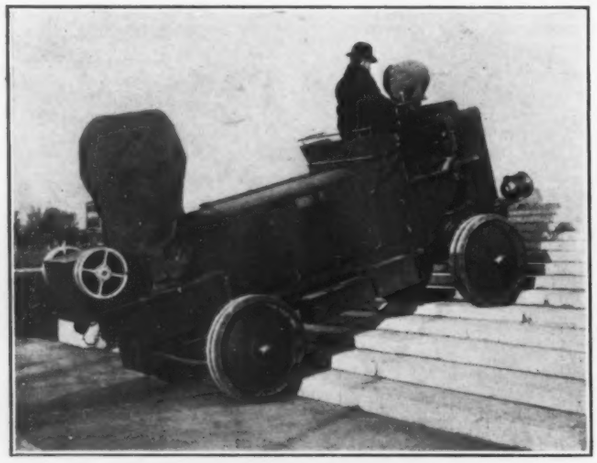


Fig. 1—Searchlantern Auto Truck Ascending Severe 35 Per Cent Grade.

A complete direct-current switchboard for the entire plant is mounted on the dash of the car, including voltmeter, field rheostat, circuit-breaker and feeder switches. The circuits are arranged so that the two searchlanterns with which the outfit is equipped can be operated independently or simultaneously. The large 24-in. projector, with Le Blanc relay control, shown in Fig. 1 mounted on the rear platform of the truck, has since been transferred to a trailer drawn behind the truck, in order to enable the latter to carry 32 gal. more gasoline in an additional tank. The weight of the truck proper has thus been decreased from 10,400 lb. to 9800 lb. and the gasoline-tank capacity increased from 55 gal. to 87 gal. The searchlantern trailer consists of a standard field-artillery caisson on which, on a spring-supported three-point suspended platform, is carried a 30-in. white-metal mirror General Electric electrically controlled searchlantern, together with 500 ft. of supply and control cables. The weight of the trailer complete is 4400 lb. A motor-driven hoist and portable field pile-driver are also built for use with the automobile searchlantern truck.

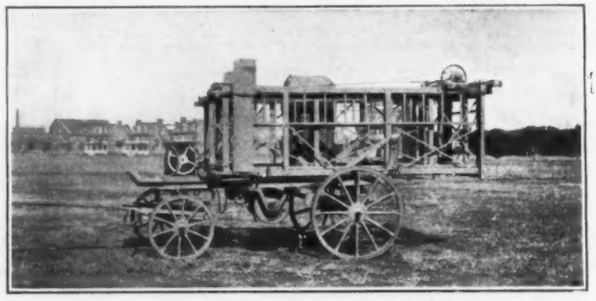


Fig. 2—Searchlantern Tower in Traveling Position.

This truck has been tested over extremely bad roads, soft plowed fields and in the ascent of hills up to 25 per cent grade, the truck pulling over all obstacles without apparent difficulty. The car can develop a 5-ton pull at standstill. On rough country roads the outfit has averaged 1.45 miles to 1.55 miles per gallon of gasoline. At loads from 60 per cent to 130 per cent of the engine rating the gasoline consumption has averaged about two pints per hp-hour. Over this range the generator shows a sustained efficiency of 85 per cent to 87 per cent.

Fig. 3—Searchlantern Tower Raised Into Position for Operating.

The advantages recognized in searchlantern operation, when the projector itself is mounted on an elevated platform, have

led to the development of the portable telescoping tower outfit shown in Figs. 2 and 3. The mounting is of German invention and is equipped with a 24-in. glass-reflector General Electric searchlantern arranged for remote control by either a Le Blanc relay or the older six-wire control. Fig. 2 shows the outfit in traveling position, with tower telescoped. To raise, the tower is first upset over the rear of the wagon and the projector run up through its internal shaft to the top, at the same time the whole upper half of the tower being untelescoped with the aid of the windlass shown. The rear posts of the base section of the tower are provided with blocks and leveling screws for adjusting the structure vertically on uneven ground. The tower is well braced and remarkably rigid, but may be guyed at its corner posts if desired. The reel under the body of the wagon carries 500 ft. of supply cable and 1000 ft. of control cable. The tower supports the lantern at an extreme elevation of 30 ft. The surrounding platform can also be occupied by six men, several of whom may be sharpshooters, as was done during the 1910 Gettysburg maneuvers, at which the auto-truck and the field artillery set were also used.

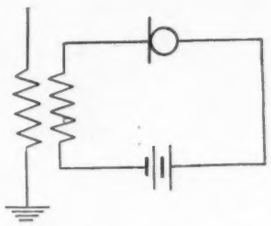
SIMPLIFIED WIRELESS TELEPHONY.

By M. Freimark.

So little has been heard of late from wireless telephony that it almost seems as if the art were entirely forgotten, or at least that it does not make any progress. It therefore gives the writer pleasure to bring out a few facts which he has observed and which he hopes will be followed up.

In the spring of 1910, while making experiments to devise a method for locating open circuits in insulated and concealed wiring, it was found that the human body acts as an excellent antenna and detector and responds remarkably to the slightest excitation from electromagnetic waves or static induction. Having perfected this method for localizing breaks in telephone wiring, a close resemblance was observed between the apparatus and a miniature wireless-telegraph sending station. The details of the apparatus, fortunately, were of a simpler and, necessarily, of a different design from those of a wireless station owing to the fact that neither a deafening spark nor high-tension currents can be tolerated on telephone lines or cables, as they would seriously interfere with transmission and insulation, and would carry beyond the break and possibly cause injury and damage to subscribers and property.

The sending outfit being identical—from a purely theoretical point of view—in the two cases, one could not help thinking why the receiving station should not be the same, and why, in particular, it should not be used for wireless telephony. To this end it was necessary merely to change the sending station to a talking circuit. An operator's telephone set answered the purpose. A few dry cells were put in series with the transmitter and the primary side of the induction coil. One terminal of the secondary was grounded, the other one serving as the sending antenna, as indicated in the accompanying illustration. The receiving station consisted of nothing more or less than a telephone receiver with one terminal connected to the body (ear or finger) and the other one to a wire which trailed on the ground or was directly connected to ground for the purpose



Antenna Connections.

of better receiving. The results were as anticipated. The sounds were audible a few feet from the antenna.

Further experiments with a phonograph, in connection with a small step-up coil, such as is used in wire-telephone practice, brought out the fact that the phonograph could be heard through the receiver anywhere in a good-sized living-room when the wire was concealed under the rugs. Metal, such as a brass bedstead or a tin roof, readily takes up the waves, acts like a sounding board and gives them off with seemingly increased strength.

The writer could not make any further investigation on the subject. It seems, however, that good results could be obtained by taking into account the standard methods and apparatus which wire-telephony has established and which have reached such a high degree of development.

It is doubtful whether a transmitter of the present type will ever be developed to withstand currents strong enough to serve directly for wireless transmission. However, there is no doubt that combinations of this transmitter with generators, transformers, arc lamps or coils can be made which will be able to transmit sound within the limits of any city, and for overland or oversea transmission very high frequency waves can be used as the carrier.

Like present-day telegraphy the method described has the disadvantage of publicity, and even more so since anybody equipped with a receiver can pick up the message; for the same reason it also has the good side—though it is only one-way transmission—that it is accessible to everybody, rich or poor.

A city equipped with such a station could, for example, send out orders to the whole police force in an instant, publish election or ball-game returns, give free concerts to the whole population and accomplish a good many other things which would tend to better the social life of its citizens.

Central Station
Management, Policies and Commercial Methods

GASOLINE VERSUS ELECTRIC LIGHTING.

The disadvantages of lighting by gasoline systems as compared with electric were well pointed out in a paper on "Gasoline Competition," by Messrs Ward Harrison and H. H. Magdsick, of the engineering department of the National Electric Lamp Association, presented before the Minnesota Electrical Association convention at St. Paul, March 16. After describing the principles on which the five classes of gasoline apparatus in general use are operated the following serious charges were made against gasoline lighting:

In even the safest system of gasoline vapor, or "greased-air," operation the pipes corrode rapidly on account of the large amount of moisture carried with the vapor, causing dangerous leaks. In systems where gasoline is carried into the building under pressure leaks frequently occur at the brazed joints of the tubing and generator, allowing gasoline to drip and so inviting fire or explosion. Practically all gasoline systems emit an offensive odor at times; in some plants this smell is always present. Roaring sounds are frequently produced at the burners and at the generator. Gasoline-lighting systems give off from ten to twelve times as much heat per cp-hour as their equivalent in tungsten lamps, and in warm weather this heat may become very objectionable, rendering it impossible to light interiors properly without discomfort to the occupants. Gasoline fixtures are ugly, and the large pipes

required with some systems detract from the appearance of interiors. Concealed piping is unsatisfactory, because when exposed to uneven temperatures the gasoline vapor becomes chilled and condenses, thereby extinguishing the lamps.

Although the Fire Underwriters issue permits for approved gasoline systems without an increase in the insurance rates, the conditions imposed provide substantially that the insurance company shall pay no claims for fires originating from the gasoline equipment. Losses have been paid in some cases where the gasoline equipment was indirectly the cause of a fire, but such action is in reality a matter of policy on the part of the individual companies. The owner of a store or building is, however, practically at the mercy of the insurance company.

Systems in which the liquid gasoline under pressure is introduced into buildings are particularly hazardous because any leaks which may occur will allow a large quantity of the liquid to escape. A small quantity of gasoline will render a large volume of air explosive; in fact, the range of explosiveness for gasoline vapor mixed with air is four or five times the range for ordinary coal gas. Perhaps the greatest danger in all gasoline systems is that due to the mere presence of the liquid. After a lighting system has been installed for a considerable period and the operator becomes accustomed to the handling of gasoline, he is likely to grow less cautious, and in the rush of business or from mere carelessness he may endanger not only his own life and property, but that of others as well. Frequently it is found that the gasoline supply has run out during the evening, and under these circumstances the temptation to replenish the tank while using artificial light can scarcely be overcome.

Insurance regulations specify that the reservoirs of gasoline-lighting systems shall be filled by daylight only, without the presence of artificial light, and with the gasoline burners not in use. No gasoline, except the reservoir contents, is allowed to be stored in the same building or those adjoining. Court decisions have shown that violation of any of the numerous restrictions in the gasoline permits voids not only the tenants' insurance policy but the policy of the building owner as well. Testimony has also shown that under strict interpretation it is impossible to handle this deadly explosive without violating some restriction embodied in the insurance permit.

Candle-power ratings on gasoline lamps show the widest divergence. The usual rating refers to bare mantles, but the candle-power is seriously diminished by the presence of globes which interfere with the supply of air and reduce the light flux by from 50 per cent to 60 per cent. Tests on rated 60-cp gasoline street lamps in Chicago showed an average of only 25.5 cp.

In considering gasoline lighting costs manufacturers reckon only the expense for gasoline, the usual claim being that from forty to fifty single-unit lamp-hours can be obtained per gallon. A recent investigation of 200 average installations showed performances ranging between actual extremes of fourteen and twenty-five lamp-hours per gallon of gasoline. The average output of 422 units in seventy-four other plants was twenty-three lamp-hours per gallon. With gasoline at 18 cents the cost of fuel will thus amount to from ½ cent to 1 cent per lamp-hour.

To the fuel expense must be added, of course, maintenance and capital charges on the installation. Mantles must be renewed often on account of the high pressures used and the small explosions occurring at ignition of the burners. Glassware becomes cracked and generator parts and tubes must be renewed. To keep lamps in good condition maintenance costs, excluding labor, of from 75 cents to $2 must be added for each lamp-year of 1000 hours. The attention and labor required by a gasoline system are by no means as insignificant as manufacturers may represent. The filling and pumping of the tank and the adjustment of the burners and generator will require usually many minutes each day, and with a common generator all the other lamps must be adjusted when another lamp is lighted. The bother of making these adjustments often leads to burning all the lamps continuously, thereby contributing to the cost of operation. The burners and gauzes become clogged and must be cleaned frequently. In many systems there is a delay in getting light while the burners are starting. Pilot flames have been provided, but, by becoming extinguished, these have caused dangerous drippings of gasoline.

Central-station rates, said Mr. Harrison, have an important bearing upon gasoline competition. A large proportion of the gasoline installations are made by long-hour users who have not received proper consideration under the straight-meter rate which is still so generally encountered. These consumers could be retained at a considerable profit to the central station if their bills were based on an attractive and more equitable system of charges. With short-hour users the danger from gasoline competition is relatively slight; their bills are low and the high first cost and fixed charges against a system of gasoline lighting will effectually prevent its installation.

The existence of a well-designed installation of tungsten-filament lamps is one indication that its owner is a progressive business man. Such an installation cannot fail to have a decidedly favorable influence upon the mind of a prospective customer. A gasoline equipment may be capable of economically lighting a building, but the electric illumination of stores and show windows is an advertising proposition that pays.

Among the anti-gasoline campaign literature cited by Mr. Harrison for enlightening the public on the dangers of gasoline lighting are the following, one of the best of which, said the speaker, is that issued by the Missouri association: *National Fire Protection Association Quarterly*, January, 1910; "A Red Light Signal," Missouri Electric, Gas, Street Railway & Water Works Association; "Gasoline as a Destroyer of Life and Property," San Francisco Gas & Electric Company; "Digest of Insurance Regulations as Applied to Gasoline Lighting," Victor S. Scott, San Antonio, Tex.; "Dangers of Gasoline," James A. Stewart, Madison, Wis.; "Inside Facts About Gasoline," E. A. Scantland, Memphis, Tenn.; *Bulletins*, National Electric Light Association, February and March, 1911; "Is Gasoline Dangerous?" Illuminating Publishing Company, Cincinnati, Ohio.

ADVERTISING CENTRAL-STATION SERVICE BY ELECTRIC SIGNS.

An interesting feature of the Boston Edison Company's own advertising practice is the use of large illuminated signs in conspicuous locations in the company's territory. Fig. 1 shows

Fig. 1—Boston Edison Sign in Newton.

one of the most prominent, which is located in the City of Newton immediately opposite the Boston & Albany Railroad Company's station and within 1000 ft. of Nonantum Square, which is the terminus of the Boston Elevated Railway Com-

pany and the Boston Suburban Electric Companies' lines. The sign is mounted at the top of a three-story mercantile building, and is of the flashing type, the sentences upon it being varied every few weeks. Nearly ninety passenger

Fig. 2—Chimney Sign on Somerville Substation of Boston Edison Company.

trains per day stop at the Newton station, and a total of about 200 passenger trains either stop or pass daily. The sign is in full view from the railroad and can also be read with ease from Nonantum Square. It is equipped with 2-cp lamps, there being about 330 lamps in the border and 450 lamps in the inscription as at present arranged. Every passenger leaving a train at Newton in the evening is inevitably bound to notice this sign, which has a strategic location excelled by no other sign in the suburban area of Boston. Another prominent sign of the company is illustrated in Fig. 2, which shows a chimney of the Somerville substation, night view. Three rows of 8-cp carbon incandescents are installed at the top of the chimney, there being 120 on the four sides. A similar installation has been used at the Natick substation, and at the Waltham station of the company a large roof sign, visible from the Boston & Maine Railroad, is used. This calls attention to the light and power service of the company, and is made up of 345 4-cp

Fig. 3—Boston Edison Talking Sign Opposite North Station, Boston.

carbon lamps. Figs. 3 and 4 illustrate a talking sign of the company which is installed opposite the North Station, Boston. This contains about 900 incandescent lamps of 4 cp each and nightly tells the story of electrical service and its advantages to throngs of passengers traveling through the northern railroad gateway of the city.

STEAM-CONSUMPTION TEST OF A SMALL CENTRAL STATION.

Analyses of the operating steam consumption of small steam-driven central stations furnish significant data to engineers interested in comparing the service performance of plants of moderate size. A representative test on an 865-kw plant serving a community of about 15,000 inhabitants was recently made by Messrs E. S. Howe and H. R. Wilbur, of the Massachusetts Institute of Technology, with the object of determining the relations of fuel consumption and output in the commercial operation of the plant and possible suggestions toward improved conditions in the station. The plant was located near the waterfront of the principal town served by the company, which supplies energy to municipal and private lamp and motor users, including a considerable street-lighting service throughout a wide countryside. The test was conducted under the auspices of the electrical engineering department of the institute.

The lighting load of the company was all single-phase in character, and the motor load was partly three-phase and partly 550-volt direct current. The latter service was supplied by a generator belted to a 150-kw synchronous motor, and the use of this equipment was found very beneficial in connection with the control of the power-factor. The boiler equipment of the plant consisted of two 250-hp B. & W. units and a 200-hp horizontal return-tubular boiler, which was not used in the test. The furnaces were hand-fired, and two Worthington feed pumps, an injector and a secondary heater were in service. All the feed water was purchased from the town supply, but ample supplies of condensing water were obtained from a large brook near the station, the brook discharging into the ocean. The feed water in the plant was run from the feed pump through a primary heater located between the engine cylinders and the condensing equipment, and thence through the secondary heater installation, from which it was passed to the boilers. The exhausts from the condenser pumps and feed pumps and the drips from the main steam line and from the heating system all run in together and pass through the secondary heater system.

The main generating units consisted of two General Electric 350-kw, 2200-volt alternators of the revolving-field type, each being a three-phase, 60-cycle machine directly connected to a Harris-Corliss horizontal cross-compound condensing engine, the engine dimensions being 15 in. x 28 in. x 30 in., and the speed 150 r.p.m. The low-pressure cylinder of one engine was connected to the main steam line through a reducing valve, and the necessary valves were placed in the exhaust connections so that if desired the engine could be run as a simple condensing machine on either the high-pressure or low-pressure cylinder. In addition to the 150-kw, 550-volt direct-current set, a 15-kw direct-current generator was provided in the plant for handling the motor load at times when the greater portion of the demand on the station for motor service is absent. The steam pressure in the plant was varied in daily operation from 65 lb. to 120 lb. gage. From midnight to morning, when the load was light, the pressure was reduced to about 65 lb. During the day it was run at about 85 lb., and in the early part of the evening at 120 lb. The object of this was to improve the economy of the engines, as they operated at about one-fourth load for six hours, at one-half load for twelve hours and at three-fourths load the rest of the time. By the reduction in pressure the company secured the benefits of a practically uniform cut-off. The condensing equipment of the plant was located beneath the engine-room floor at the sides of the engines served, both condensers being of the jet type, with an individual feed-water heater between each engine and its condenser. The condensers were of Warren and Worthington make, and the feed-water heaters were of National make. The exciters were belt-driven from the engine shafts and were interpole machines rated at 180 amp at 115 volts. The exciters

could be operated in parallel or singly as desired, and two sets of main three-phase busbars were provided for the generators. The output of the alternators was controlled and measured at a switchboard of eight panels. Each feeder circuit was provided with an oil switch to each bus, so that the maximum flexibility of operation was secured, and the oil switches for each feeder panel were interlocked so that one switch could not be closed until the other was open to obviate the danger of throwing a circuit on each bus at the same time, which would cause trouble if the generators were running independently one on each bus, and out of phase.

TABLE I.—RESULTS OF A SEVENTY-TWO-HOUR PLANT TEST, EXPRESSED IN PER CENT.

Flue gas loss	22.8
Radiation from boilers	9.6
Primary heater	4.8
Secondary heater	4.4
Engine thermal loss	40.6
Engine mechanical and generator loss	1.7
Condensed steam loss	4.4
Auxiliary steam consumption loss	5.7
Leakage to idle boiler	0.2
Drip from steam mains loss	0.2
Radiation from steam mains, loss	0.6
Output at busbars	5.0
Total	100.0

TABLE II.—ANALYSIS OF TEST DATA.

Total coal burned in 72 hours (New River), pounds	36,840
Thermal value of coal per pound as fired, heat units	14,180
Corrected boiler-feed water in 72 hours, pounds	305,915
Total busbar output in 72 hours, kw-hours	7,700
Mean indicated horse-power of engine	193
Boiler efficiency, per cent	67.6
Engine thermal efficiency, per cent	16.7
Engine mechanical and generator efficiency, per cent	74.3
Pounds water per kw-hour output, per cent	39.7
Pounds coal per kw-hour output, per cent	4.78

The test further showed that 45.7 lb. of air per pound of coal were required; the total heat units carried off by gases per pound of coal was 3230, and the proportion of heat units carried off per pound of coal was 22.8 per cent. The steam contained 3 per cent of moisture. The boiler pressure averaged 98.3 lb. absolute, and the mean boiler output was 147 hp. The consumption was 67,900 heat units per kw-hour.

CONSTANT-LOAD ENGINE TESTS.

Three methods were considered with the object of securing a load which could be maintained with safety to the commercial service on the ground of non-interruption and with minimum danger to the persons making the test.

The first method was to run the test load on one generator connected with a water rheostat, with steam supply from two of the three boilers. The method would permit the load to be balanced exactly, but would introduce errors in the steam consumption for the reason that the boiler working on the commercial load is fed from the same water supply as the other two boilers. A Venturi water meter would be necessary on the boiler-feed pipe in this case.

The second method was to run the test load in parallel with the commercial load when the latter was not fluctuating and when it was heavier than the desired constant output. The constant output would have to be maintained by 2200-volt alternating-current rheostats, which are objectionable, although they permit the load to be nicely balanced and the boiler feed could be accurately measured.

TABLE III.—RESULTS OF CONSTANT-LOAD TESTS.

Mean kilowatt output	90.0	177.0	218.7	297.4
Pounds steam per kw-hour	36.1	28.6	29.7	31.8
Per cent efficiency of engine and generator	8.85	11.21	10.81	10.13

The third method, which was adopted, was a modification of the second method, the plan being to run the water rheostat in parallel with the 500-volt direct-current load. The 500-volt machine was driven by a 2200-volt synchronous motor, as stated above, and this method permitted accurate boiler-feed measurements to be made, although the load was not exactly balanced. The unbalancing of the load was insufficiently large to make an appreciable difference in the steam consumption, and there was a slight gain in the safety of operating the commercial load besides a decided gain in the safety of handling the artificial load at the water rheostat. The power-factor was kept at unity by the adjustment of the synchronous motor-field currrent.

DISCUSSION OF TEST POINTS.

Five per cent of the input reaches the busbars, which is about what would be expected for a small plant running under the conditions of the test. It was found that at certain times during the twenty-four hours the load on the three phases is considerably unbalanced. A better distribution was advised on account of its ability to reduce heating in the generators and lines to slight extent, and primarily because it will increase the accuracy of the station meters, some of which were running under unnecessarily light load conditions. The saving in the primary heater was indicated at about half what it should be and the conclusion was that the heater was provided with too small a heating surface or that it was operating inefficiently on account of scale or oil accumulating in the pipes. Thorough washing with caustic soda and water was advised. Similar treatment appeared desirable in the case of the secondary heater. It was also deduced from the tests that the engines operated most satisfactorily at 160 kw output. This point of maximum efficiency should correspond closely with the average station load. During the seventy-two-hour test the average load on the station was 107 kw, but this was less than the average load because one or two mills were not taking their full amount of power. When the average load changes considerably, the engine valves should be reset to give maximum efficiency at the new average load. A more rapid rise in boiler pressure with increase in load would prevent the efficiency curve from dropping so rapidly at the heavier loads. It was not feasible to determine the correct boiler pressure for any given load from the tests made, but it was pointed out in the test report that the best pressure could be obtained for any given load by comparison of boiler pressure with cut-off as shown by indicator cards taken at that load. The best engineering practice dictates that the best economy will be secured when cut-off occurs at about one-third stroke, or at as little above one-third stroke as is consistent with well-formed cards. This rule holds except at very light or very heavy loads. All instruments were carefully calibrated before and after the test.

Wiring and Illumination

TUNGSTEN POST LIGHTING WITH PRISMATIC REFLECTORS AT CINCINNATI.

About thirty-six ornamental street-lighting posts have been erected in Cincinnati employing a newly developed adaptation of the prismatic reflector to deliver a larger percentage of the light flux from the lamps down onto the pavement below.

Where an incandescent lamp is inclosed in a plain frosted-ball globe the distribution from the globe is, of course, practically that, diminished, of the lamp itself. On account of the large flux near the equatorial plane of such lamps it has been urged that this distribution is not best adapted for ornamental street lighting where the posts are spaced at short intervals along the curb. With the idea of projecting a larger part of this horizontal and upward flux onto the pavement beneath, a combination reflector and globe has recently been marketed in which the frosted globe is open at the bottom and contains a prism reflector surrounding the lamp. This reflector receives and redirects most of this light downward, while whatever gets through the interstices between the reflector prisms serves to illuminate the upper frosted globe as in other ornamental systems. One of the first installations of these reflectors for curb-lighting service was made about two months ago along

several city blocks in Cincinnati, and careful records are being kept for checking the performance of the new system.

The five-lamp posts in Cincinnati carry 100-watt tungsten lamps on each side-arm and a 60-watt lamp in the top positions. Only the side-arm lamps are equipped with the reflectors. The outer whitened or frosted globes are open at the bottom and are held in position by flanges of the inner prismatic reflectors which inclose the lamps. A special 100-watt tungsten

Fig. 1—Race Street, Cincinnati, Lighted by Tungsten Posts with Reflectors.

lamp, with concentrated suspension of the filament, is used in the reflector outlets. The top globe is of plain milk glass, but shaped so as to conform to the other globes.

The first posts erected, on Fourth Street between Vine and Race Streets, carried the lamps 10 ft. 6 in. above the sidewalks, but this height was found to be too low, as "spotting" was produced in the lighting of the pavement below. In the second installation, on Race Street, between Sixth and Eighth Streets, the posts were lengthened so as to carry the lamps 12.7 ft. above the street surface.

This higher position has partially avoided the "spotting" first noticed, but to even a casual observer the illumination along the sidewalk varies widely between points under the posts and at midway distances. Viewed along the street, merely as decorations, the lighted globes also clearly lack the brilliancy found with unshaded 100-watt lamps.

At first fears were felt that the increased complexity of this glassware would make it cost more for cleaning. These objec-

Fig. 2—Ornamental Lighting Pillar with Prism Reflector at Cincinnati.

tions have not been realized, however, as only the outer surface of the milk globe and the inside of the reflector appear to become dirty, even in Cincinnati's smoky atmosphere. Once a week an attendant rubs over these accessible surfaces with a cloth, cleaning them effectually. Once a month he takes down the two pieces of glassware and washes their unexposed surfaces. The cleaning cost thus seems to be only slightly different from that for simple glass globes.

The chief difficulty that has thus far made itself apparent at Cincinnati is the cracking of the outer milk glass, due, probably, to constraint against expansion, caused by the way the globes are clamped. A walk up Race or Fourth Street shows a number of cracked outer globes, besides those which have probably been replaced. As the price for equipping a five-lamp post with this reflecting glassware is about $15, or six or seven times that of simple glass globes, the cost of maintenance due to breakage may become important in the upkeep of such a system of curb lighting.

The present blocks of ornamental curb lighting in Cincinnati are trial installations, the erection of which was financed by the merchants. Energy for the lamps is paid for by the city out of the general lighting fund. In the new street-lighting contract, bids for which have just been advertised, it has been proposed to install this form of lighting only in the downtown section of Cincinnati. The present lamps burn from dusk to midnight only.

Careful records of the performance of this curb lighting are being kept by the Union Gas & Electric Company, of Cincinnati, which furnishes the energy to operate it. The installations have now been in service only a few weeks, but after a month or two the distribution department of the company, of which Mr. F. J. Healy is superintendent, will probably be able to offer a complete report on the cost of maintenance of the reflectors.

ILLUMINATION OF THE CATHEDRAL OF ST. JOHN THE DIVINE, NEW YORK.

Of all the handsome edifices for religious services in New York City the Protestant Episcopal Cathedral of St. John the Divine is the most splendid and monumental in plan, and even in its unfinished state it is imposing and impressive. The cathedral is situated on the rocky eminence overlooking Morningside Park, and when completed will be the fourth largest cathedral in the world, being surpassed in size by St. Peter's, Rome; the Cathedral of Seville, Spain, and the Duomo, at Milan.

The architectural style is Romanesque influenced by the Byzantine. The plans show a cruciform structure 520 ft. long, 165 ft. wide across the nave and aisle, 288 ft. wide across the transepts, covering an area of 99,500 sq. ft. The crowning de-

Fig. 1—Unfinished Cathedral of St. John the Divine.

tail will be an imposing central tower planted on a base 100 ft. square directly above the crossing and rising to a height of 425 ft. Two smaller towers are to be located at the front of the edifice and four in the angles formed by the intersection of the nave and transepts. The dome of St. Paul's Cathedral, in London, is of slightly greater span, but is lower by 36 ft. than that of the Cathedral of St. John the Divine. Surrounding the choir will be seven chapels, the Chapels of the Tongues, two of

which have been completed, and the work on two others of which will shortly be commenced. Of the cathedral the choir and a part of the crossing are complete and will be dedicated with impressive ceremony on April 19. The cornerstone of the cathedral was laid in 1891 and work has been advanced as fast as funds, which come from voluntary contributions, have allowed. The cost of the completed structure is estimated at over $10,000,000, of which $4,000,000 has already been expended.

The massiveness and enduring nature of the construction may be understood from the photographs reproduced herewith. The four great arches which will hold the tower are 12 ft. wide, 14 ft. 3 in. thick at the springing line (74 ft. above ground level) and 12.5 ft. at the crown, and contain 1180 cu. yd. of granite masonry. Each of the main piers on which they rest is 21 ft. square and has bearing against it two flying buttresses with an average thickness of 12.5 ft. The great arches, piers and flying buttresses, all of which are constructed of granite, will be concealed when the cathedral is finished by the exterior architectural features and by an interior finish of buff-colored limestone. The roof, floors, etc., are supported from stone arches, no steel framework being used at all. A feature of the interior is the eight giant granite columns surrounding the reredos. Each of these is 18 ft. in circumference, 54 ft. high and weighs more than 130 tons. The beauty of the interior is best brought out at night under the light of the electric lamps. Owing to the absence of the rich stained-glass windows which will adorn the cathedral when completed the view by day lacks the softness of color necessary to impart the requisite ecclesiastical dignity to the edifice and its furnishings. Much of the electric work at present in use is temporary, but the greater part of the work in the sanctuary and choir is permanent. The lighting equipment of this part of the cathedral is worked out as an entity, although all of it is not to be used at present. The lighting fixtures at present used are temporary and will give place to architectural fixtures, lanterns, etc., in keeping with the edifice when specific appropriations for that purpose are made.

Electricity for all purposes is supplied from the mains of the New York Edison Company, the installation being made by Messrs. Peet & Powers, of New York, under the direction of Mr. J. R. Moore, electrical engineer. The choir and sanctuary are lighted chiefly from strips hidden behind the piers. Numerous floor pockets are also arranged in the mosaic tiling in the choir and sanctuary floor wherever candelabra are likely to be required. The sanctuary strips, shown in Figs 4 and 8, also encircle the arch above and are arranged in 24-ft. sections which can be lowered on a sliding rail for relamping by means of a windlass. There are sixty-eight lamps rated at 16 cp in vertical-mirror reflectors of the Frink type on each of the sanctuary piers. In the arch above these are 104 lamps and the strips are arranged to be readily relamped from an opening at the side of the arch. The arch being about 120 ft. high, some provision had to be made for renewing lamps and the plan adopted has worked very well. The chancel arch has no lamps in it, but strips are arranged back of the piers as in the case of the sanctuary and a similar arrangement prevails for relamping the strips. There are forty-eight 40-watt tungsten lamps on each side of the choir space and these give ample light for the choristers. In the rich canopies surmounting the stalls for the

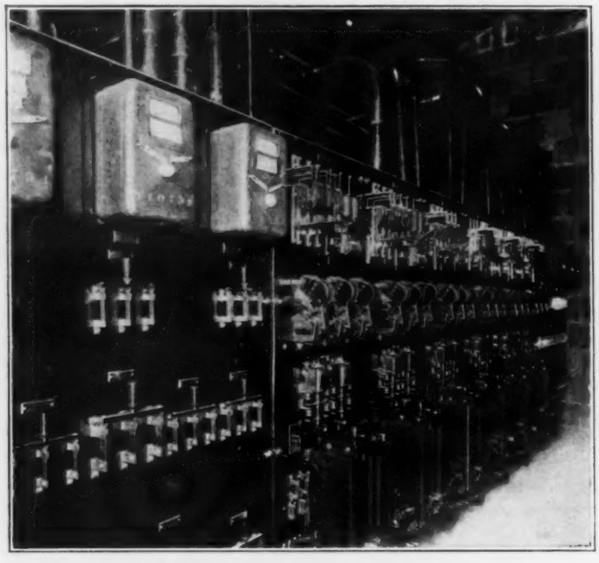


Fig. 3—Automatic Switches and Dimmers.

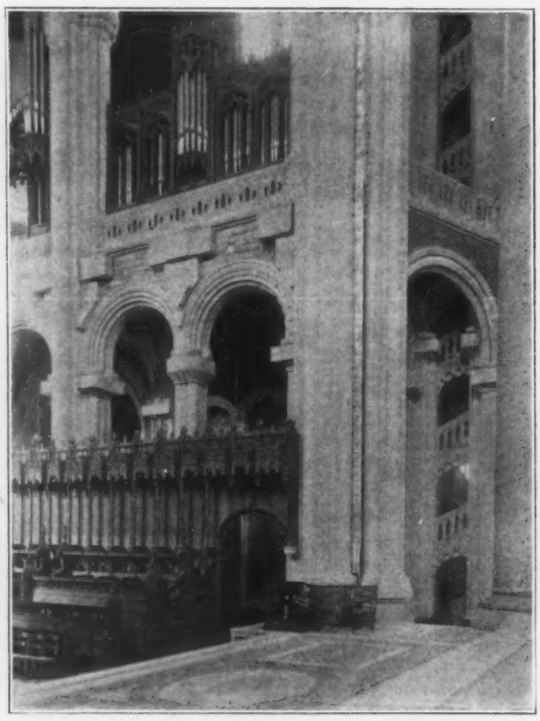
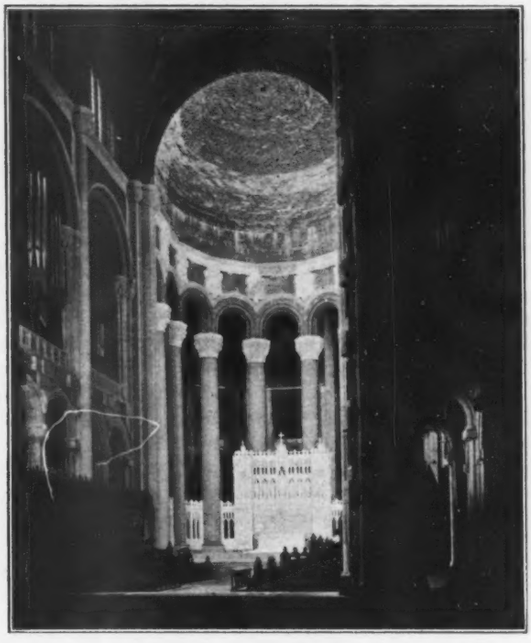


Fig. 2—Portion of Strip on Sanctuary Pier.

Fig. 4—Temporary Fixtures in Aisle Back of Organ.

clergy in the choir there is an opening covered with a disk of amber glass about the same color as the oak wood of which the screens are made. These disks are not noticeable by day and at night the light from 16-cp lamps shines through with a beautiful effect. There are twenty-one lamps hidden in these canopies on each side of the choir.



Figs. 5 and 6—Choir and Sanctuary of the Cathedral of St. John the Divine as They Appear by Day and by Night.

The lighting of the choir and sanctuary is subject to remote control by means of special switches. Every other lamp on the piers and arch is connected to a dimmer circuit and the alternate lamps are sub-controlled by automatic switches. The push-button control is arranged in a closet back of the choir screens, and similar switches are arranged at the side of the organ, giving the organist control of the choir lighting. By means of a pilot lamp over the push button one can ascertain before starting the dimmers if all or half of the lamps are in circuit, the lamp indicating whether the automatic switch is closed or open before starting (it will be understood that the attendant is in a closet and out of sight of the choir and sanctuary). By means of other push-button switches all or half of the lamps can be thrown in circuit. A supplemental contact on the automatic switch built by Messrs. Flucker & Keedwell, New York, enables this control to be effected.

Fig. 3 shows a view of the switchboard in the basement with the dimmers at the bottom and the automatic switches at the top. Each of the six individual operating dimmer panels shown controls groups of lamps independent of each other. Some of the dimmers are constructed to allow separating the lamps into groups controlled by switches at remote points.

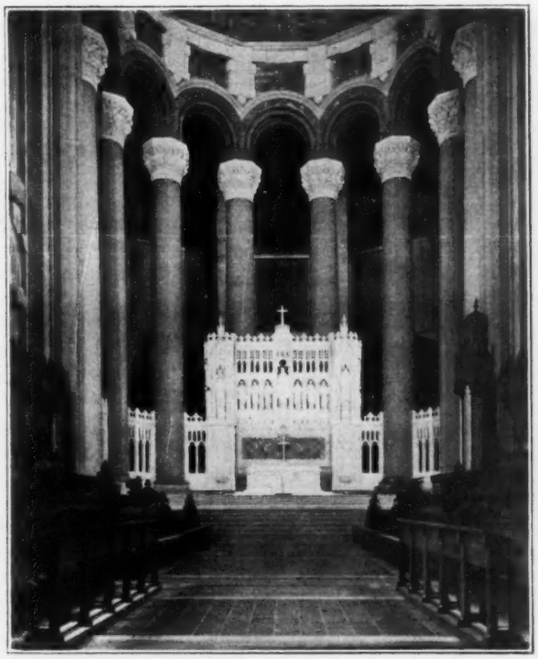


Fig. 7—Reredos Lighted from Strips on Sanctuary Piers and Arch.

Fig. 8—Strip Lighting on Piers in Choir and Sanctuary.

Either one of the groups can be dimmed or brightened independently or both can be controlled alike. The principal parts of the dimmer arrangement consist of three solenoid-operated clapper-type switches for the three-wire circuits and a cross-head type commutator over which the brushes pass, driven through a screw shaft and spur gear by a ⅛-hp, 220-volt motor. The resistors are mounted in an angle-iron frame on the rear of the panel and comprise cast-iron grids and inclosed-type units. The 30-amp, 250-volt switches mounted on the panels control the motor circuits. Two solenoid switches operated by means of push-button switches reverse the motor armature circuit. One push button is located on each panel and similar ones are mounted as before mentioned, so that the solenoid switches can be operated to control the motor and, therefore, the dimming of the lamps remotely. The arrangement of the resistance permits of very fine and gradual variations in light brilliancy, causing glowing and fading by imperceptible degrees. The dimmers, which are of Cutler-Hammer Manufacturing Company design, are arranged so that the motors will automatically shut down whenever the lamps are either totally dimmed or totally brightened, and further when the lamps are totally dimmed the three clapper-type switches will open the main line, cutting off the energy and preventing waste.

In addition to the lamps on the sanctuary and chancel piers, the four great windows over the organ are arranged to add to the general effect. About 20 ft. back of each of these windows three rows of lamps in individual Frink reflectors are arranged to be brought up to full brilliancy on dimmers. There are sixty 80-watt carbon-filament lamps in each chamber, which have their light directed against the amber leaded-glass windows under the dome of the choir. These windows are not visible in any of the illustrations, being too high to come within the focus of the camera.

The temporary lighting in the unfinished crossing is obtained from three-lamp brackets on the walls and from rows of lamps located high up near the spring of the arches. The crossing as it now stands is 100 ft. square and is without obstruction of any sort clear to the temporary dome, about 150 ft. above the floor. The problem was to illuminate this vast expanse without thrusting the source of illumination, which must of necessity be temporary, conspicuously into view. It was found that sufficient light could be obtained by arranging a row of forty 125-watt lamps in individual reflectors on each side of the crossing. There are in addition three rows of thirty-five 16-cp lamps without reflectors fastened to the tie rods at present used across the arches in the crossing until the nave and transepts are added.

The immense organ arranged on both sides of the choir is equipped with a 26-hp motor on one side and a 7-hp motor on the other, driving blowers of the Spencer Turbine Cleaner Company, of Hartford, Conn. The aisles back of both sides of the organ through which the Chapels of the Tongues are reached are lighted temporarily by three-lamp fixtures attached to the organ frame and by Benjamin clusters dropped from the ceiling. The two magnificent chapels already built and those shortly to be commenced will be lighted from candelabra fed from floor pockets.

RECENT TELEPHONE PATENTS.

CIRCUIT SYSTEMS.

In most standard common-battery systems there are associated with each subscriber's line two relays, the line relay for energizing the line lamp and the cut-off relay for extinguishing the line lamp. To combine these functions in a single relay is the object of Mr. A. H. Weiss, of Chicago, in the system described in a patent recently granted to him and assigned to the Kellogg Switchboard & Supply Company.

The control relay is made two-stage. It responds to the removal of the subscriber's telephone operating through its first stage and closing the line-lamp circuit. With the response of the operator the currents are increased and the relay completes its action, thus performing the cut-off relay functions.

An intercommunicating system has been patented by Mr. A. K. Andriane, of San Francisco. The system is adapted for use where each station must select and ring any other one desired. The object is to simplify the present methods and circuits. This patent is assigned to the Direct Line General Telephone Company.

Mr. F. W. Adsit, of St. Paul, Minn., has obtained a patent for a step-by-step lock and selective system. A feature is an automatic clearing of the line with the return of the receiver to the hook at a calling station. This is caused by the release of a spring which is automatically wound incidental to signaling and which upon releasing drives the generator to send out a reverse current.

NEW APPARATUS.

While most telephone sets are provided with gongs there have been a few instances where the ringer has had to tap upon some part of the apparatus to give a signal. In these cases the containing case or some similar part has been used and the idea of utilizing the transmitter mouthpiece in this way is novel. According to the patent of Mr. C. L. Chisholm, of Marysville, New Brunswick, Canada, a seat for the ringer is formed in the transmitter mounting and a U-shaped double-end clapper taps alternately opposite sides of the transmitter to give the signal.

The patent granted to Mr. W. A. Soles, of New York City, describes a locking attachment for telephones. A sheet-metal bar, shaped for its particular use, blocks the hook switch and is held in place by a padlock which prevents its withdrawal.

Mr. V. Tardieu, of Arles, France, has designed and patented a breastplate transmitter in which the transmitter proper with its casing may be readily removed from the breastplate and a new one substituted.

PORTABLE CONTACT POLE.

A portable pole for tapping a telephone circuit at any point has been patented by Mr. G. J. Bayless, of Oakland, Cal. The pole carries two metallic arms at its extreme end. These swing about the end of the pole, being held by a spring joint in the position set. They are insulated from each other. The pole is a jointed one, very light.

LETTERS TO THE EDITOR.

Strength of Poles.

To the Editor of Electrical World:

Sir:—In his report of "An Experimental Determination of the Strength of Full-Sized Telephone Poles" in your March 16 issue Mr. L. S. Winchester states that his values for the modulus of elasticity are too low on account of "the give of the butt in the ground." Actually, however, his calculations involve a second error tending in part to offset the first. This purely mathematical error may be worth pointing out in detail, since it is one which must always be guarded against when applying the ordinary formulas to large deflections.

The fundamental equation of the common theory of flexure is

$$\frac{\frac{d^2y}{dx^2}}{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}=\frac{M}{EI} \qquad (1)$$

y being the deflection of the neutral axis at x. The formula

$$y=\int\int\frac{M}{EI}dx\,dx \qquad (2)$$

used by Mr. Winchester is good for small deflections only, since it is derived from (1) by neglecting $\left(\frac{dy}{dx}\right)^2$. Mr. Winchester is careful to enumerate the "three assumptions" underlying the equation for fiber stress, but in common with many other writers, he fails to note this fourth assumption peculiar to the flexure equation.

An exact integration of (1) will be found to yield, in place of (2), the relation

$$y - y_{x=0} = \int_0^x \frac{\phi\, dx}{\sqrt{1-\phi^2}} \qquad (3)$$

in which x is measured from the location of zero slope, and ϕ denotes $\int_0^x \frac{M}{EI}\, dx$. For a beam of uniform section fixed at one end ($x=0$) and loaded at the point $x=l$,

$$\phi = ax\,(2l - x) \qquad (4)$$

where a denotes $\frac{F}{2EI}$, the other symbols having their conventional significance.

To get an estimate of the errors incurred in the case of Mr. Winchester's timber poles by using the common formula (2), instead of the exact formula (3), which I here propose, consider for example pole No. 1, in which the deflection was 60 in. (In other cases the deflections ran as high as 103 in.) A tapering pole may be represented by one of uniform section by adopting the equivalent movement of inertia. $I = \frac{\pi}{4}(r_1^3 r_2)$ where $r_1 > r_2$. With this understanding the data for pole No. 1 combine to give to a the value 4.4×10^{-6}, leading to a deflection of 60 in. upon substitution in the common formula

$$y_{max} = \frac{Fl^3}{3EI} = \tfrac{2}{3}\, al^3 \qquad (5)$$

The question therefore becomes, what value of a (and hence of E) will give the actual deflection of 60 in. upon substituting into the exact formula (3) instead of into the common formula (5)? The graphical integration of equation (3) gives y_{max} X 49 in. when $a = 4 \times 10^{-6}$ and 63 in. when $a = 5 \times 10^{-6}$, from which the true value is seen to be $a = 4.8 \times 10^{-6}$ when $y_{max} = 60$ in.

The error, then, is $\frac{4.8 - 4.4}{4.4}$, and the conventional method of calculation has led to a figure 9 per cent too large for the modulus of elasticity.

Washington, D. C. MAYO DYER HERSEY.

Regenerative Control.

To the Editor of Electrical World:

SIR:—The article upon regenerative control by Mr. J. G. V. Lang in the issue of March 30 fails to take into account a very important item, namely, the additional cost of motors of sufficient size to withstand being run without any cooling period; this is the real determinative feature of all forms of electric braking. If the motors must be 50 per cent larger and the car wiring must be designed on a more liberal scale, and the controllers provided with extra contacts, with safety devices made necessary by the increased current in the local circuits, the interest on the added cost may very well wipe out all the saving by regenerative control, without regard to the added repair charges on the more complicated equipment. Unfortunately, predetermination of these items has not proved entirely accurate.

New York, N. Y. T. J. JOHNSTON.

Digest of Current Electrical Literature

ABSTRACT OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Turbo-Alternators with Cylindrical Rotors.—A paper read before the Birmingham Section of the (British) Institution of Electrical Engineers. The author dealt with the characteristics of turbo-alternators with non-salient poles, giving special attention to the shape of the e.m.f. wave-form. The author points out that the general opinion is that a sine-wave is the best, and states that the non-salient pole machine closely approaches the ideal in this respect. Taking a rotor slotted uniformly over the whole periphery with equal-sized slots containing the same number of conductors and a few slots in the middle of each pole left unwound, the ratio of the number of wound to the number of unwound slots may be called β. Formulas are developed giving the harmonics which will be present in the e.m.f. curve for any value of β, and the results show that the more the winding is concentrated—that is, the lower the value of β—the greater is the amplitude of the fundamental curve, and consequently the higher the e.m.f. By concentrating the winding, therefore, the output is increased, or, conversely, fewer ampere-turns are required for a given output. Thus, taking the amount of copper required for a given output at 100 per cent with $\beta = 1$, the amount of copper is 84.5 per cent for $\beta = 0.8$, 78.7 per cent for $\beta = 0.7$, and 74 per cent only for $\beta = 0.6$, which is the lowest value of β found in practice, owing to the difficulty of accommodating the winding in the slots. Turning to the question of harmonics, the author points out that all harmonics above the fifth are negligible because of their small magnitude and low winding factors. The third and fifth, however, may reach 10 per cent and 5 per cent respectively of the fundamental in the flux wave in passing from β from 0.9 to 0.6, but on account of the influence of the winding factors with distributed windings the amplitude of the fifth harmonic in the e.m.f. wave is generally less than 1 per cent, and in a non-saturated machine can also be neglected. At $\beta = 0.66$ the third harmonic is zero, but for other values this harmonic becomes appreciable and may reach nearly 7 per cent in the e.m.f. wave of a three-phase machine. In order, therefore, to obtain a sine-wave flux and e.m.f. curve the value of β should be chosen between 0.7 and 0.6. The best distribution from all points of view is obtained with β from 0.85 to 0.65, as then there is plenty of space for the copper and the heating is more distributed. Considering the influence of saturation, the author shows that this causes the flux curve to be rounded off and tends to improve the shape of the wave. In a salient-pole machine the flux and pressure curves are more or less skewed and distorted, but this does not occur in a non-salient pole machine, because both stator and rotor m.m.f. curves are practically sine curves; and as the reluctance of the magnetic path is constant for any position the flux under load is simply the sum of these two curves at the proper displacement, and is therefore also a sine curve. The e.m.f. curve will also be a sine curve. The non-salient pole machine adapts itself readily to standardization. For 50 cycles, machines up to 2000 kw are made two-pole for 3000 r.p.m.; up to 5000 kw, four-pole for 1500 r.p.m., and up to 5000 kw, six-pole for 1000 r.p.m. A very few diameters are chosen for each speed, and the outputs are varied by alternating the core length. The air-gap, teeth and cores are identical. The open-circuit characteristic will thus be the same for all machines of one diameter. —Lond. *Elec. Eng'ing*, March 23.

Reactance of Electric Machines.—J. REZELMAN.—A continuation of his long serial on synchronous and non-synchronous reactance. In the present instalment the author gives the results of tests of a 75-kva alternator with salient solid poles. As in former articles the author considers the reactance when the rotor is first removed and when it is put in place, and in the latter case he investigates the variation of the reactance with the position of the rotor. Finally the operation of the alternator as a non-synchronous motor is investigated.—*La Lumière Elec.*, March 18.

Lamps and Lighting.

Metallic-Filament Lamps.—G. S. MERRILL.—A paper in which

the author first discusses the physical properties required in materials from which lamp filaments are to be made. It is desirable that the filaments possess a high positive temperature-resistance coefficient, since the greater the value of the coefficient the less the changes in current, wattage and candle-power with fluctuations in applied voltage. One per cent increase in voltage will give approximately the following percentage increase in current, watts and candle-power:

	Per Cent Increase in Current.	Per Cent Increase in Wattage.	Per Cent Increase in Candle-Power.
Tungsten	0.59	1.59	3.73
Tantalum	0.72	1.72	4.27
Graphitized carbon	0.77	1.77	4.90
Treated carbon	1.07	2.07	5.69
Untreated carbon	1.31	2.32	7.10

These figures apply only to relatively slow changes in voltage. The author then discusses the effect of selectivity and emissivity and gives a comparison of the lengths and the diameters of filaments of various kinds which would be required to produce lamps of the same candle-power and voltage at the same luminous efficiency. In the conclusion of the paper some interesting microphotographs of the cross-sectional fracture of metallic filaments are given and tests are described for determining the mechanical strength of the filaments.—*Jour. Franklin Inst.*, April.

Electric Lighting of Docks.—A. Boje.—A detailed illustrated description of the electric lighting equipment of docks in Stettin Harbor in Germany. A comparison is made from practical experience between lighting the docks on the one hand with both arc and incandescent lamps and on the other hand with metallic-filament lamps alone. It is shown in great detail that the latter method, using metallic-filament lamps alone, gives not only a stronger and more uniform illumination, but is also considerably cheaper. Comparative details of cost of operation are given for both systems.—*Elek. Zeit.*, March 23.

Leading-in Wires.—A note on a recent British patent (13,295, March 16, 1911) of the British Thomson-Houston Company (General Electric Company of this country). A short length of drawn ductile tungsten or molybdenum wire is used as a leading-in conductor for incandescent lamps. The wire is dipped into fused potassium nitrate before sealing it into the glass, as it is necessary that it should be free from dirt and oxide.—Lond. *Elec. Eng'ing*, March 23.

Traction.

High-Pressure Direct-Current Traction.—H. K. Whitehorn.—An illustrated article in which the author draws attention to the advantage of continuous current at pressures up to 3000 volts for railway working, and describes the various methods available for using such pressures. Statistics are given of a number of lines employing continuous current at pressures above the usual 500 volts, the aggregate length of route so equipped being about 800 miles.—Lond. *Electrician*, March 24.

Installations, Systems and Appliances.

Safety Automatic Switch and Plug.—An illustrated description of an automatic switch and plug for use in dangerous situations, such as coal mines, magazines, bunkers, etc. The switch contains an electromagnet so arranged that it holds in the "on" position the double-pole switch when current is passing through it, but should no current be flowing the magnet ceases to be energized and the circuit is broken. The socket also contains an electromagnet so arranged that when current is passing through it a small bolt is lifted, which locks the movable plug so that it cannot be withdrawn while the current is on. The magnets in both switch and plug are in series with the rest of the circuit. By the use of this apparatus it is impossible to insert or withdraw the plug from the socket while the latter is alive, and any accidental breakage in the continuity of the circuit, due to a broken lamp, etc., instantly causes the double-pole switch to open, the whole of the wiring in the dangerous area thereby being made dead. It will be seen from Fig. 1 that only one lamp is controlled by each plug, and the circuit can be used only when everything is in thorough working order.—Lond. *Elec. Review*, March 24.

Feeder Regulator.—A. R. Garnier.—An illustrated description of a method of voltage regulation of feeders in use in France. The regulator is essentially a voltmeter with contacts electrically connected with series and shunt instrument transformers so that when the voltage in the line varies a relay circuit is closed which operates a motor to bring the armature of the regulator to its position so as to produce again the normal voltage. The article is illustrated by several diagrams.—*L'Industrie Elec.*, March 10.

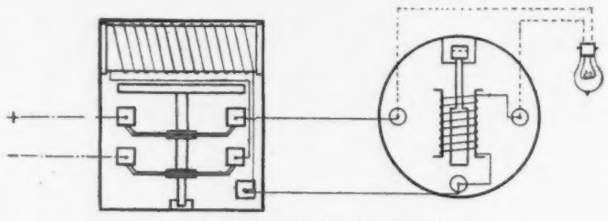


Fig. 1—Safety Automatic Switch.

Electrophysics and Magnetism.

Brownian Movements.—H. Fletcher.—A paper giving mathematical notes on the theory of the Brownian movements with an application to the determination of the elementary quantity of electricity by Ehrenhaft. The author gives an explanation of the irregularities observed by Ehrenhaft and proves the possibility that all the small particles observed by Ehrenhaft may have been of the same size and may have carried the same electric charge.—*Phys. Zeit.*, March 15.

Electrochemistry and Batteries.

Regenerating Old Battery Plates.—An article on a new chemical process for regenerating old storage-battery plates. "The old negative plates, riddled with cracks between the active material and the grid, are dipped in a bath of certain chemicals, baked for a short time and then reduced electrolytically to eliminate all impurities. This treatment has the effect of expanding the material so that it fills up all interstices and cracks. The treated plate is more uniform, of higher conductivity, and, as the material has expanded, is more porous than before the treatment. Furthermore, the material is much harder than that of new plates, and, it is claimed, retains this hardness after formation. A complete battery is made up from the negative plates of two old ones, one of the outer of each set of plates which is to be positive being cut off, so that both outside plates are negative. It is stated that apart from the saving effected by the regeneration of exhaust plates the regenerated batteries have a longer life and an efficiency from 10 per cent to 15 per cent higher than the original batteries, and at least equal capacity." Of a number of 46-cell regenerated traction batteries of a London electric automobile company, one has completed its life with 4500 miles, which is 1000 miles above the average figure for a new battery. The cost of such a battery is less than one-half that of a new one.—Lond. *Elec. Eng'ing*, March 23.

Purification of Water by Ozone.—G. Erlwein.—An illustrated description of the new ozone purification plant of the water works of the City of St. Petersburg in Russia. It supplies sterilized water to a district consuming daily 50,000 cu. m (13,200,000 gal.) of water. The water of the river Neva is first filtered and treated with aluminum sulphate to precipitate the suspended matter. The filtered water is then subjected to treatment by ozone. The Siemens & Halske ozonizer is employed. There is a special electric power plant containing two 150-hp generators. The cost of operation in practice, including the cost of aluminum sulphate and rapid filtration, is from 0.40 cent to 0.45 cent per cubic meter of water.—*Met. and Chem. Eng'ing*, April.

Fixation of Atmospheric Nitrogen.—J. Vanderpol.—A de-

tailed description with illustrations of the new works of the La Nitrogène company in La Roche de Rame, Hautes-Alpes, France, using the Pauling process for making nitric acid and nitrates from air. The chemical reactions which take place are summed up and the construction of the Pauling furnace is described and illustrated. An account is also given of the treatment of the gases containing nitrogen oxide for change into nitric acid.—*Met. and Chem. Eng'ing,* April.

Heat Insulation of Furnace Walls.—CARL HERING.—An article giving the general principles of the heat insulation of furnace walls with the aid of the analogy of the flow of heat to that of the flow of electricity.—*Met. and Chem. Eng'ing,* April.

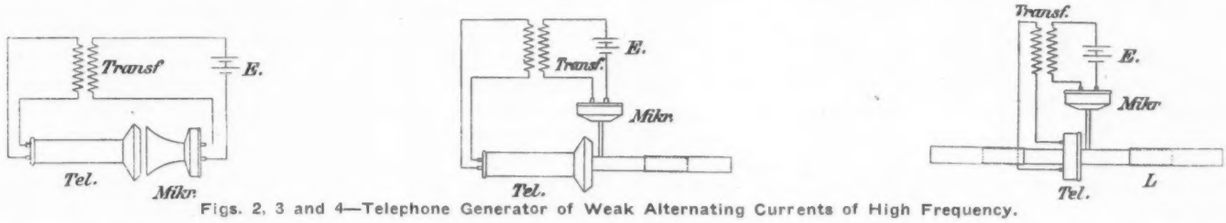
Laboratory Furnaces.—G. H. GOODWIN.—An article illustrated by detailed drawings on an electric furnace in which granular carbon is employed as resistor. Within the granular carbon a graphite container is embedded for a working or removable crucible.—*Met. and Chem. Eng'ing,* April.

Vanadium.—W. F. BLEECKER.—A second article of the serial on the chemistry and metallurgy of vanadium. In the present instalment the author deals with methods of analysis, including an account of electrolytic methods.—*Met. and Chem. Eng'ing,* April.

Units, Measurements and Instruments.

Telephone Generator of Weak Alternating Currents.—A. LARSEN.—A telephone can be made to give out a sound if it is placed before a microphone with which it is connected by means of a transformer, as shown in Fig. 2. The condition of oscillations is rather unstable, and if the relative position of the telephone and microphone is only slightly changed the sound given out by the telephone may change considerably. The reason is that the mass of air which oscillates is of decisive importance. The author has therefore changed the arrangement as shown in Fig. 3, where a brass pipe is screwed on to the mouthpiece, the length of which can be adjusted by drawing extension tubes out more or less. Through a thinner side tube the air in this extension tube is connected with the microphone as shown in the illustration. The frequency of the sound can then be regulated within considerable limits by changing the length of the extension tube. A certain irregularity is experienced with this arrangement which is due to the oscillations of the air in the hollow space behind the telephone diaphragm. When the hollow space is filled with paraffine the irregularity disappears. This arrangement is especially suitable for frequencies above 1000 cycles per second. For lower frequencies the arrangement was changed as shown in Fig. 4, in which a telephone of the box or disk type is used and identical extension tubes are attached to it on both sides, which may be drawn out so as to change the length. With this arrangement it is easy to vary the frequency from about 600 cycles to 1100 cycles per second. Fig. 5 shows the change of the frequency with changes of the length of the extension tube. The abscissas give the length of the tube in centimeters. The ordinates give for curve *a* one-fourth the wave-length in centimeters and *b* the frequency in cycles per second. For the higher frequencies the length of the extension tube is only a little greater than one-fourth of the wave-length. This arrangement is an easy, cheap and satisfactory generator of weak alternating currents of a frequency of 600 cycles to 1100 cycles per second. It is advantageous to use a second transformer to reduce the voltage to a value suitable for measurement. Since the oscillations chiefly depend on the mass of air, the wave of the sound is almost sinusoidal. When the apparatus is started the frequency may change in the beginning by about 1 per cent, but afterwards the frequency will remain constant for hours to about one-fifth of 1 per cent.—*Elek. Zeit.,* March 23.

Measuring Low Resistances.—An illustrated description of an instrument of British make called the "ducter," for measuring low resistances; for instance, for comparison of contact resistances of switches, testing all sorts of joints, bonds, etc. The moving system is composed of two coils, in planes at an angle to each other, carrying currents proportional to that passing through the resistance to be tested and to the drop of potential across it respectively. This system is free to swing in a permanent magnetic field, and the position which these coils and the pointer take up depends on the direction of the resultant of the forces due to the currents in the two coils, and is thus determined by their ratio, which is proportional to the resistance to be tested. The fundamental principle is, therefore, the same as that of the "megger," which is an instrument for measuring high resistances. The main differences are due to the fact that whereas in the megger the drop of potential amounts to some hundreds of volts and the current through the resistance is infinitesimal, in the ducter a series current measurable in amperes is employed, but only a diminutive drop is produced. Thus the working current is supplied from a few



Figs. 2, 3 and 4—Telephone Generator of Weak Alternating Currents of High Frequency.

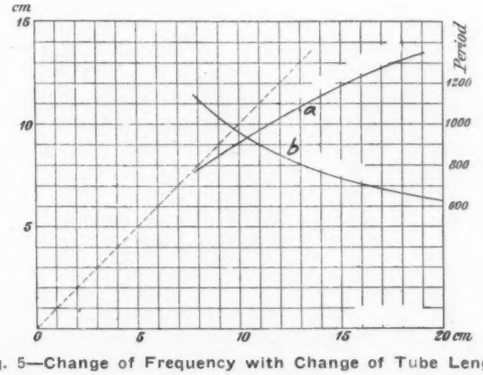


Fig. 5—Change of Frequency with Change of Tube Length.

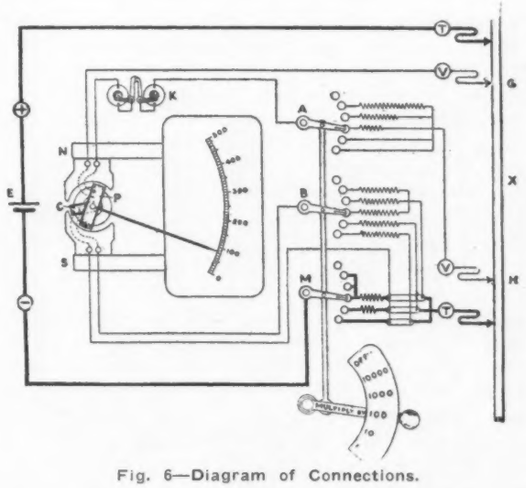


Fig. 6—Diagram of Connections.

storage cells instead of from a high-voltage generator, and suitable shunts are employed in connection with the current coil. The connections are shown in Fig. 6, in which *E* is the battery, *C* current coil, *P* potential coil, *N S* poles of magnet, *K* cut-out, *A B M* triple-pole grade switch, *X* resistance under test, *H G* potential contacts,—Lond. *Electrician,* March 24; Lond. *Elec. Eng'ing,* March 23.

Calorimetry.—W. P. White.—The first of a series of articles on recent progress in calorimetry. In the present article the author discusses the real versus the supposed errors and shows that the cooling connection instead of being the largest is easily

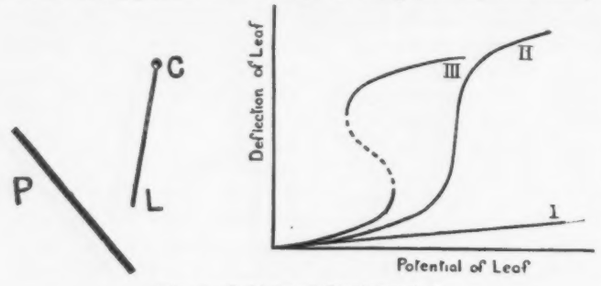


Fig. 7—Gold-Leaf Electrometer.

made the least of the sources of calorimetric error, that evaporation, while much more serious, can also be controlled without difficulty, as can the heat produced by the stirrer. The way to control evaporation is practically to prevent it. With the stirrer the essential thing is to find the proper speed. Lag effects, though numerous and complicated, may easily be made to produce negligible errors. The total inaccuracy of the calorimeter, therefore, is much less than the usual error of the temperature measurement. This error can be greatly reduced, though at the cost of considerable complications, by using electrical thermometers. It can be very easily, though less effectively, reduced by increasing the temperature interval through which the calorimeter is heated. The general opinion that small intervals are generally advantageous or conducive to accuracy is a fallacy.—*Met. and Chem. Eng'ing,* April.

Gold-Leaf Electrometer.—G. W. C. Kaye.—A paper read before the British Physical Society describing a new form of the tilted gold-leaf electrometer. (Fig. 7, left-hand diagram.) An insulated gold leaf *L* hanging from *C* is attracted out of the vertical by an inclined charged plate *P* in its proximity. An alteration in the potential of either causes *L* to move. Depending on the tilt of the plate *P*, the relative potential of *P* and *L* and the proximity of *P* and *L*, the equilibrium of the leaf may either be stable over the whole of its path or unstable over part of it. The right-hand diagram illustrates the possibilities that may occur with the electrometer, the potential of the plate being constant. In curve I the deflection of the leaf increases steadily with the potential on it, and throughout there is a complete stability and only moderate sensitiveness. In curve III there are, for a certain range of potentials, two positions of equilibrium for the leaf. The central dotted portion of the *S* is experimentally unrealizable and indicative of instability. By adjusting the conditions curve II can be obtained. Here the deflection is single-valued throughout, and although the sensitiveness is high over part of the path there is complete stability. The critical curve between stability and instability will have a vertical portion indicating infinite sensitiveness, and the tilted electroscope derives its sensitiveness by working as near as may be expedient or desirable to this critical state. For any particular tilt of the electrometer there is a plate potential which will yield a maximum sensitiveness. The less the tilt (or the angle of the plate to the vertical) the greater is the plate potential required and the greater the maximum sensitiveness, until the critical tilt is reached beyond which comes instability over some region. The extent of this unstable region increases as the tilt diminishes. The author discusses the various points to be observed in the practical construction of the electrometer so as to obtain the best results. The cutting and mounting of gold leaves and the features of the various insulators available for electrometer work are discussed in two appendixes.—Lond. *Electrician,* March 24.

Direct-Current and Alternating-Current Electromagnets.—P. R. Friedlaender.—Considerable discrepancies have often been noticed between the pull exerted by an electromagnet when excited with direct current and that exerted by the same magnet (or one of the same dimensions, only modified to avoid eddy-current losses) when used on a single-phase alternating-current circuit at the same current. In many cases this is partly due to the effect of iron saturation, but, quite apart from this factor, considerable differences still occur. These are essentially due to the fact that the length of the working air-gap varies periodically when the alternating current is in use, and thus interferes with the shape of the time curve of the flux. This periodic variation of air-gap is generally made very obvious by the variation and noise set up by such magnets, especially just before the armature is attracted or released. The author describes experiments that were made for the object of studying the difference between direct-current and alternating-current electromagnets. In the case of plain solenoids pulling on straight, laminated iron cores no measurable difference between the pull with direct current and the pull with alternating current of the same mean effective value could be detected with either short or long coils. In such cases a small change in the position of the iron core has very little effect on the pull—the effective air-gap, and consequently the flux, being hardly altered at all. When, however, magnets of the more usual type having a practically all-iron magnetic circuit and a comparatively small air-gap were tested a marked difference between the pulls on direct current and alternating current was obtained. Some typical results, as obtained on a small laminated horseshoe electromagnet, are given. For this particular magnet with an air-gap of 0.01 in. and a magnetizing current of 1 amp the ratio of direct-current pull to alternating-current pull is about 0.69 when lifting and 4.3 when dropping. With a 0.04-in. air-gap and 3 amp the ratio is 0.71, when lifting and 2.1 when dropping. With an air-gap of 0.187 in. and 8 amp the ratio is 0.88 when lifting and 1.35 when dropping. It will be seen that the difference between the alternating-current and direct-current pulls gets steadily less as the air-gap length increases owing to the diminishing percentage effect of a given fluctuation in air-gap length.—Lond. *Elec. Review,* March 17.

Wave-Meter.—R. Hirsch.—Wave-meters now in use are based upon the principle of resonance. In these the amount of capacity or self-induction of an oscillating circuit is varied until an indicator connected in the circuit shows a maximum current or voltage. As the wave-length for each reading of the measuring circuit is known, the wave-length of the primary circuit can be found by a determination of the reso-

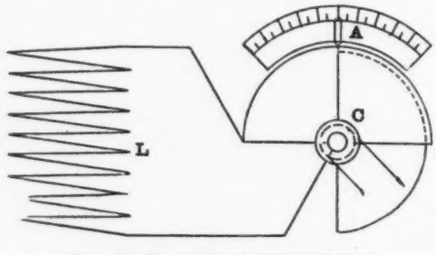


Fig. 8—Diagram of Wave-Meter.

nance. The determination of the wave-length follows in every case from an adjustment of the position of the resonance. The direct-reading wave-meter described by the author, and shown in Fig. 8, depends on the same principle. *C* is an adjustable condenser, *L* a self-induction which can also be adjustable and *A* a gas tube as the voltage indicator, which is in parallel with the self-induction or capacity. One of these, the self-induction or the capacity, or a combination of both, is rotated quickly by means of clockwork or by a small electric motor so that it periodically passes through its range from the

smallest to the highest values, consequently the resonance position is passed during each revolution and the voltage indicator indicates this each time. As this always happens in the same position (that of resonance), it is continuously shown by a thin streak of light. If the gas tube be made to turn over a scale already calibrated in wave-lengths, the wave-length or frequency can be read off immediately. By a simple switching off of the condenser the wave-meter can be transformed into a so-called oscillation indicator, when it no longer indicates the constancy of the wave-lengths, but the strength of the oscillations and their clearness.—Lond. *Electrician*, March 17.

Errors in Measuring Instruments Due to High Voltages.—J. Zenneck.—If a commercial instrument for precision measurements is inserted directly in a high-voltage line, there are two errors due to the high voltage. The first is due to electrostatic influence, the second due to discharges in the damping device. While the errors due to the first source are comparatively small up to 6000 volts, the errors in the second case may become serious even at 4000 volts. The simple remedy for the second source of error is to provide a conducting connection between the stationary and the movable part of the damping device.—*Phys. Zeit.*, March 15.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—T. T. Baker.—An illustrated description of various arrangements for wireless telegraphy from aeroplanes. An earth connection being impossible, the use of balanced aerials is recommended. Several methods of connections are shown.—Lond. *Electrician*, March 17.

Book Review.

Principles of Electrical Engineering. By Harold Pender, Ph.D. New York: McGraw-Hill Book Company. 340 pages, 126 illus. Price, $4.

In the nine chapters of this book the fundamental principles of electrical phenomena that have a bearing upon engineering designs and undertakings are treated in a masterly manner. Beginning with fundamental ideas and units and passing through electricity, at rest and in motion, magnetic phenomena treated alone and then in connection with electricity, the author deals with continuous, variable and alternating currents, with the symbolic method of treating alternating-current phenomena and with three-phase circuit problems.

The language employed is essentially mathematical, in that practically all of the arguments and conclusions are based upon mathematical representations of the fundamental electromagnetic relations and the equations derived therefrom.

The book is one which can be used for reference only by those who are familiar with mathematics, and especially calculus. However, as a book intended for instructional purposes in engineering colleges where calculus is taught it should prove highly advantageous for two reasons, namely, the practical application of calculus to engineering problems and the convenient expression of electromagnetic relations in the language of calculus. Both those who have studied the average uninteresting textbook on calculus and those who have attempted to teach the average illogical textbook on electrical engineering in which calculus is used spasmodically will appreciate the value of a book written throughout in the language of calculus and arranged in such a logical order as to serve as text simultaneously on simplified calculus application to engineering problems and the expression of engineering principles in calculus in an understandable manner.

Not much of the book is devoted to alternating-current problems, so that in only a few cases are harmonic time functions employed. In view of the widespread use of convenient graphical methods for representing alternating-current relations it is to be regretted that the author has not discussed vector diagrams and their applications more fully. The treatment given is such that the student, even when thoroughly familiar with both calculus and electromagnetic phenomena, is apt to forget that the equations represent physical relations rather than mere mathematical quantities. That is to say, the student would be greatly inclined to confuse cause and effect when, as is here the case, the two are expressed in the form of equations with much too little explanation as to their physical significance. This criticism is not applicable to other portions of the book, which as a whole is exceptionally well arranged for instructional purposes in engineering colleges or for continuous reading by any one familiar with calculus who wishes to become better acquainted with electrical engineering problems and their solutions, or one familiar with electromagnetic relations who wishes to increase his knowledge of the application of calculus.

New Apparatus and Appliances

CLOCK NUMERALS ON MERCHANT'S ELECTRIC SIGN.

D. Sommers & Company, household furnishers, Indianapolis, Ind., have erected a large tungsten-lamp sign on the roof of their eight-story building, a feature of which is a series of electrically illuminated figures giving in hours and minutes the time of night. As this sign commands the principal street-car waiting place, it is useful to the public as well as a good publicity investment for the advertiser. The main sign is 80 ft. long and 22 ft. high, and contains 1250 5-watt, 10-volt tungsten lamps supplied through a sign-lighting transformer with energy from the lines of the Merchants' Heat & Light Company, of Indianapolis. The clock numeral-boxes at the right top corner of the panel are 7 ft. high and contain about 200, 110-volt carbon-filament lamps. The switching of the proper combination of lamps to form the numerals giving the hours and minutes is performed by an eight-day clock movement, which at one-minute intervals starts a small motor, each time advancing the switch mechanism one notch. The second-hand shaft of the clock at each revolution momentarily opens the circuit of a solenoid, the armature of which drops and closes the motor circuit. Through gearing and ratchets the motor drives three switch-arms, one over each of three face-plates with radial rows of contacts, corresponding to the three right-hand numerals. One starting of the motor advances the minute switch-arm one notch over its face-plate. When it has moved ten notches, the next or ten-minute arm is moved once ahead; when this has moved six steps, the hour-switch is advanced.

The clock mechanism to control this sign is the first of this kind to be built for the purpose. It is housed in a roof-cabin containing the electric-elevator machinery, and can be advanced or adjusted by hand control if necessary. The Sanborn Electric Company, Indianapolis, erected the sign, the clock feature of which was furnished by Betts & Betts, New York.

ELECTRICITY AT BOSTON IDEAL HOME EXHIBITION.

Various applications of electricity were effective in enhancing the attractiveness of the Boston Ideal Home Exhibition, held in Horticultural Hall during the early part of the present month. In the preparation of domestic exhibits portable tungsten lamps

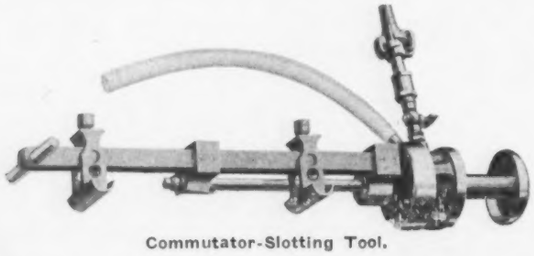
of 100-cp rating were employed, with the result that expert carpentry work was greatly facilitated and delays reduced to the minimum. The lighting of the main hall was effectively accomplished by about 150 tungsten lamps of 80-watt rating, spaced about 3 ft. apart on the under sides of the Gothic arches surmounting the room, with the addition of about eighty carbon incandescent lamps of the 16-cp rating installed beneath the roof monitor. Extensive uses were made of reflector lamps in connection with the lighting of signs at exhibits, and miniature lamps were employed in the interior lighting of model concrete houses poured on the Morrill system. Portable houses and hot-water heating equipment were also equipped with electric lighting, and in the case of the latter apparatus the operation of the inner mechanism was exhibited more clearly than would have been practicable with any other method. Other applications included the lighting of confectionery signs of colored glass and the concentrated illumination of an elaborate exhibit of photographs and drawings showing recent architectural progress in the City of Boston. The Boston Elevated Railway Company maintained a motor-driven exhibit of revolving photographs of historic points of interest in the company's territory. Other exhibitors included the Brackett, Shaw & Lunt Company, Boston, which displayed a directly connected pump for shallow wells driven by a 0.5-hp, 115-volt motor, the gears being run in oil and the pump operating through double connecting rods; the Electric Renovator Manufacturing Company, Pittsburgh, Pa., "Invincible" vacuum cleaners; the Pneuvac Company, Boston, electrically driven cleaners; 1900 Washer driven by motor; Minneapolis Heat Regulator, and the Santos vacuum cleaner.

COMMUTATOR-SLOTTING TOOL.

In any motor where there is a tendency toward sparking, due to defective design, hard usage or the presence of dirt, the destructive action of the spark causes the burning of the commutator segments at the trailing side. This reduces the level of the copper below that of the mica, which, on account of its refractory nature, remains almost unaffected and holds the brushes off the copper, thus aggravating the trouble. The destructive action once started proceeds rapidly, precluding good motor operation. Slotting out the mica to a depth of 1/32 in. or 1/16 in. below the surface of the copper makes possible proper contact of the brushes on the bars and, in addition, permits the use of soft brushes, leading to longer life of commutator. The slotting of commutators is now followed as a general practice by some of the large operating companies, particularly in railway work.

The Westinghouse Electric & Manufacturing Company, Pittsburgh, builds two types of slotting tools for this purpose. One type is pneumatically operated and the other electrically operated.

The slotting tool comprises a circular saw, with adjustable rests for centering the tool. Guides bearing on the commutator face are adjustable on the guide bar of the tool, making it applicable to a large range of commutator sizes. The guides also permit the depth of slotting to be accurately adjusted and maintained.



Commutator-Slotting Tool.

The pneumatically operated slotting tool is operated by an air turbine at a pressure of 40 lb. to 80 lb. per square inch. The air turbine forms part of the tool. The electrically operated slotting tool is satisfactorily operated by a 0.25-hp motor running at approximately 1700 r.p.m. A 5-ft. flexible shaft is provided for connecting the tool to the motor.

STEEL REFLECTORS FOR LARGE INCANDESCENT LAMPS.

When the tungsten lamp was first placed on the market it represented a small unit of high efficiency that by frequent spacing nearer the plane gave a more uniform illumination than was possible with larger units, such as arc lamps, placed at greater heights and further apart. The extended use of these incandescent units has developed their practicability under almost any condition of operation until now the larger units through their convenience and economy are replacing arc lamps hung at any height.

Fig. 1—Steel Reflector.

In many industrial plants it is advisable to use lighting units hung high above the plane to clear moving cranes or large machines, and in such places a 250-watt or 400-watt lamp under a reflector confining the lighting flux within a narrow angle is very suitable.

The accompanying illustration shows a steel reflector designed particularly for this service, together with photometric candle-power distribution curves relating to its use with 250-watt and 400-watt lamps.

The reflectors are at present built only with porcelain-enameled surfaces. While a matte-aluminum surface has a higher coefficient of reflection, the average industrial plants where such large units can be installed to advantage are too dirty to admit of the use of any reflecting surface that cannot be readily cleaned. The porcelain-enameled surface is impervious to moist and acid atmospheres, and as these reflectors are used with skeleton holders which insure thorough ventilation, the circulation of air around the lamps prevents an undue accumulation of dust on the surface of the lamp or reflector and prevents a shortening of the life of the lamp through overheating. This reflector has been placed on the market by the Wheeler Reflector Company, 156 Pearl Street, Boston, Mass.

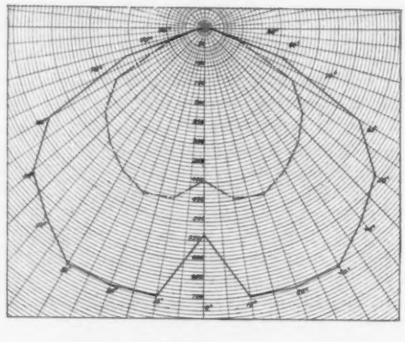


Fig. 2—Candle-Power Distribution.

ARC-WELDER GENERATOR.

The use of the electric arc welder for burning off risers on steel castings, patching large and small holes in castings and for other work of this kind is a branch of the electrical science which has not been extensively developed.

The great advantage of the arc process in work of this kind has made it practically the only method of accomplishing the results named in actual operation. However, since the arc itself takes from 30 volts to 35 volts and the e.m.f. usually employed in the steel foundries is at least 220 volts, there must be some kind of transforming apparatus to bring the e.m.f. down to a voltage which can actually be used. Heretofore a resistor was employed in series with the arc for this purpose and more recently motor-generator sets. Both methods of necessity entailed losses and in the first method about half of the energy was dissipated in heat.

The Lincoln Electric Company, Cleveland, has developed a machine which eliminates entirely the use of resistance to give the variable voltage at the arc which is absolutely essential to the best results. Its efficiency is very high, since only one

Generator for Arc Welding.

machine is used, and its cost is low compared with that of a motor-generator set. This machine is fundamentally a variable-voltage machine, the voltage of which is controlled entirely by the inherent regulation of the machine itself, so that by varying the length of the arc the amount of current produced is automatically regulated by the machine itself. Thus, on open circuit with a 220-volt supply the e.m.f. at the arc is about 130 volts, while with a short-circuit and the same supply the e.m.f. at the arc is from 1 volt to 2 volts. The voltage under actual operation will vary with the length of the arc.

The entire weight of this outfit, including control board, is about 1500 lb., so that it may be carried around to different parts of the foundry on a truck with very little inconvenience.

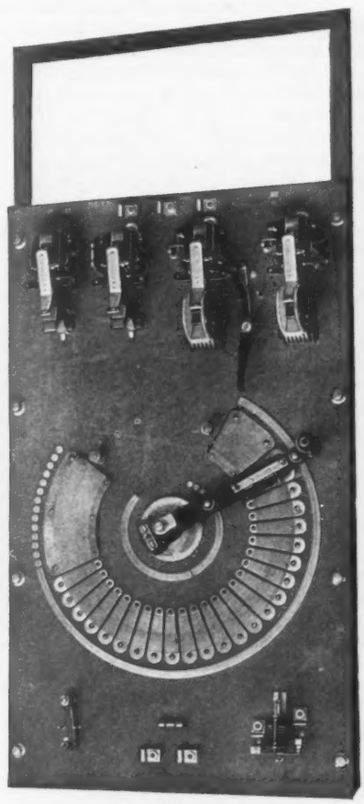
The efficiency that this machine will give under actual operating conditions is high on account of, first, the entire lack of resistance in series with the arc and the small amount of no-load losses in comparison with a two-machine equipment. This saving will amount to about 85 per cent in comparison with the use of large ohmic resistance and about 50 per cent in comparison with the motor-generator set.

ROTARY PRINTING-PRESS CONTROLLERS.

The type of controller shown herewith has been developed for use with rotary newspaper printing presses driven by single motors. These controllers give a low speed of 10 per cent of the normal speed by a combination or resistance in series with the armature and a resistance shunted across the armature.

The series armature resistance reduces the motor speed 50 per cent below normal and accelerates the press under load conditions. The armature-shunt resistance is controlled by a solenoid switch, which is energized from the motor armature voltage when the main controller lever is on one of the first four speed points. The low speed is adjusted by setting the main lever on one of these points and shifting a small link on the panel to adjust the amount of resistance shunted across the armature.

The line circuit to the motor is controlled by a solenoid



Controller for Rotary Newspaper Press.

switch provided with heavy copper and carbon arcing contacts and a powerful magnetic blowout. This switch is operated from any of the control switches and is so interlocked with the main controller lever that the motor circuit cannot be closed unless the proper amount of armature resistance is in circuit. This protects the motor and press from a failure of voltage and subsequent restoration thereof. A dynamic brake stops the motor quickly and smoothly whether actuated from the control switches, from the overload relay or when the main controller lever is moved to the "off" position. From any of the control switches the motor may be started, run at the low speed or stopped.

When the rotary press is ready to print the motor can be accelerated to the printing speeds by the main lever of the controller. The press can be stopped by moving the controller lever to the "off" position, by the stopping switch on the controller panel or from any of the control switches. This controller has been placed on the market by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., and supplements the company's regular line of printing-press controllers.

Industrial and Commercial News

The Week in Trade.

CONTINUED depression in commercial circles brought further disappointment to the business world last week. Reports from all lines of trade and industry were disappointing and the long-expected change for the better which the optimists have been predicting has been further deferred. Even the near approach of Easter has done little to stimulate retail trade and reports from the Western merchants are unsatisfactory. For this condition the unseasonable weather is held partly responsible. There has been little encouragement for the purchase of light clothing, and the season has now progressed so far that the carry-over of stocks of this kind promises to be unusually large. The one bright feature of the situation is the excellent outlook for magnificent crop returns. The rain and snow which have restricted retail business have at the same time vastly improved winter wheat and the crop condition generally. In the iron and steel industry there is very little new to be noted. Some growth in orders is reported, but is not of sufficient magnitude to call for any especial celebration. The railroads are very slow to place orders for either rails or equipment and there is little prospect that this policy will be changed until the revival of business brings about more encouraging financial reports. While there are fewer idle cars just at present than were reported two weeks ago, the number is more than double that of the same period a year ago. Structural material is in somewhat better demand, and wire products are still being purchased in large volume. Collections are distinctly slow and are not expected to improve to any material extent until retail business is better. Business failures for the week ended April 6, as reported by *Bradstreet's*, were 236, as compared with 260 the previous week, 240 for the same week in 1910, 227 in 1909. 258 in 1908 and 194 in 1907.

The Copper Market.

PRODUCTION of copper in March, as shown by the report of the Copper Producers' Association, broke all previous records since this association has been preparing statistics. This was particularly disappointing to those who are still optimists in the market, and was surprising to the entire trade. The large output is particularly striking when it is remembered that efforts have been made during the last six months to keep down production to a point somewhat nearer the actual consumption and to prevent the piling up of surplus stocks. The menace of this continued accumulation of metal that cannot be consumed by the melters is well understood. As long as the money market remains as easy and rates as low as at present it is not difficult for either the refiners or the speculators, who are well loaded up, to carry the burden. If these conditions change and interest rates advance to normal figures, demoralization is not unlikely. According to the figures of the March report, the surplus stock of copper held by the producers at the end of the month was 162,007,934 lb., an increase of 5,370,164 lb. during the month, and of about 40,000,000 lb. since the beginning of the year. The production for the month was 130,532,080 lb., an increase over February of 20,703,783 lb., and the addition to the surplus would have been much larger except for the unusually heavy takings during the month both for domestic and foreign delivery. These amounted to 125,161,916 lb., an increase over February of 29,531,899 lb. The large domestic deliveries were due to the eager buying of copper-wire manufacturers who, on account of keen competition and price shading, disposed of a tremendous amount of their product. The low price at which electrolytic was offered during the month also stimulated the purchases for export. In Europe there was only a fair buying, and this was mainly by small interests. The large manufacturers of both England and the Continent are reported to be heavily stocked. During the past week sales of copper were light and prices still showed a disposition to sag. The exports for the month, including April 10, have been 7 667 tons. The daily call on the Metal Exchange, April 10, quoted standard copper as per accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.70	11.85	.....
April	11.70	11.85	11.77½
May	11.70	11.85	11.77½
June	11.70	11.85	11.77½
July	11.70	11.85	11.77½

The London market, April 10, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	54 1 3	54 0 0
Standard copper, futures	54 12 6	54 11 3

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.77½c
London, spot	£56 15 0	£53 15 0
London, futures	57 12 6	54 10 0
Best selected	60 5 0	57 15 0

Industrial and Commercial Notes.

Westinghouse Sales of Traction Equipment.—The Westinghouse Electric & Manufacturing Company has recently made quite a number of important sales of traction equipment, among which are the following: To the Toledo, Bowling Green & Southern Railway, of Findlay, Ohio, four quadruple equipments of interpole railway motors with latest type hand-operated unit-switch control; to the Georgia Railway & Electric Company, Atlanta, Ga., six additional double equipments of motors with control equipments; to the Johnstown (Pa.) Passenger Railway Company, five double equipments of motors with control; to the Fairmount (W. Va.) & Clarksburg Railway Company, four additional quadruple equipments of interpole motors with hand-operated unit-switch control; to the City Railways Company, of Dayton, Ohio, ten double equipments of interpole motors with control; to the Nashville Railway & Light Company, four double equipments of interpole motors and control; to the Cincinnati Traction Company, nine quadruple equipments of interpole railway motors and hand-operated unit-switch control, and to the British Columbia Electric Railroad, two forty-five-ton locomotives with quadruple equipments of interpole railway motors and automatic unit-switch control.

China's New Telephone System.—The two telephone exchanges which the Western Electric Company has been installing in the city of Peking, China, were cut into service on April 2. These exchanges are of the common battery type and are equipped for 6400 lines apiece. At present 3000 subscribers' lines are connected to this telephone system, which is owned and operated by the imperial government. The need for a telephone system in China became so apparent a couple of years ago that an imperial commission was sent abroad to study the telephone systems of other countries. The commissioners were impressed with the service in New York City and recommended an equipment along similar lines for the Chinese capital. The contract was awarded to the Western Electric Company, and the cost of the original equipment is in the neighborhood of $150,000. Underground cable, 3.5 in. in diameter and containing 400 paper-insulated wires, has been used. The telephone system will employ about thirty operators, all of whom will be Chinese girls. English-speaking operators will be employed on the switchboard section installed for use of foreign residents.

Electric Storage Battery Company.—The Minneapolis General Electric Company has recently contracted for a large emergency storage battery to be installed on its system by the Electric Storage Battery Company. It will consist of 150 "exide" cells and will have an output of 10,500 amp at the twenty-minute rate of discharge. This will be the third battery installed by the Electric Storage Battery Company for the Minneapolis General Electric Company. The same company has also contracted with the Consolidated Gas, Electric Light & Power Company, of Baltimore, for an emergency battery which, it is said, will be the largest storage battery in the world. With plates and electrolyte, it will weigh 1,079,200 lb, and is to be capable of lighting 240,000 20-cp tungstens for twenty minutes.

Philadelphia Electric Company Residence Lighting.—The March bulletin of the Philadelphia Electric Company states that the number of Philadelphia dwellings in which electricity is used increased 2000 in 1910, and that electricity will be supplied in 2000 which are now being erected.

Twenty-fifth Anniversary of Carbon Business.—Hugo Reisinger celebrated on April 1 the twenty-fifth anniversary of the establishment of his business as importer of carbons and other electrical supplies. The employees of the firm presented Mr. Reisinger with an artistic address bound in leather and silver, with the signatures of the entire staff attached. Mr. Reisinger was the pioneer in the importation of carbon arc-lamp electrodes to this country, and was the first to cause to be manufactured at the works of C. Conradty, Nürnberg, inclosed-arc and flaming-arc electrodes. Mr. Reisinger took a prominent part two years ago in the fight for a lower tariff on arc-lamp electrodes, and it was largely through his personal effort that the rate of $1 per hundred feet at first proposed in the new tariff bill was reduced to 65 cents. Mr. Reisinger suggested that 20 cents per hundred feet would be about fair, but it was impossible to push this reduction through. Outside of business Mr. Reisinger has devoted a great deal of time to art matters, and has promoted the exchange of works of art between America and Germany. He was honorary commissioner general for Europe to the World's Fair at St. Louis in 1904, has twice been decorated by the German Emperor and once by the Prince Regent of Bavaria. He is an active member of the New York Chamber of Commerce and a director in many important companies.

Crude Rubber Still Unsettled.—The crude rubber market still remains in an unsettled and excitable condition, although trading is very dull and prices seem to be on the decline. Manufacturers, especially the insulated-wire makers, are buying for only pressing and immediate needs. No stocks are being carried and contracts are based on the price of rubber at the time of signing. It is the general opinion among American rubber consumers that the market is in the hands of the speculators and is being manipulated without any regard to the laws of supply and demand. As one insulated-wire manufacturer put it: "The reason for the sudden decline in rubber during the latter half of March and the present comparatively low price is that the London speculators who represent the Brazilian rubber syndicate depressed prices in order to take in the surplus stocks cheaply and also to be able to buy the Ceylons offered at auction in March at bargain rates. This syndicate practically controls the Para output and as soon as it can gather in the loose rubber in Europe I expect prices to be advanced." Just at present business in insulated wire is very dull, and little rubber is being bought, but the manufacturers are hopeful that the new Underwriters' specifications will increase orders.

Telephone Apparatus for Seaboard Air Line.—The Seaboard Air Line Railway is placing orders with the Western Electric Company for telephone train-dispatching equipment covering more than 600 miles, with two complete circuits. This installation is being made as a direct result of the increased economy of the telephone over the telegraph as experienced by over a year and a half of service on divisions extending from Richmond to Raleigh, with a branch to Portsmouth, Va., and from Raleigh to Monroe, N. C. The first new division being equipped centers at Hamlet, N. C., and extends in one direction to Wilmington, a distance of 111 miles; south to Columbia, 106 miles, and west to Rutherfordton, 157 miles, making a total of 374 miles, equipped with thirty-six stations. The second division extends from Jacksonville, Fla., to Tampa, with branches to Orlando and Venice, 265 miles in all, on which will be installed thirty-eight way station equipments. This equipment is of the latest type manufactured by the Western Electric Company, which installed the present equipment on the Seaboard Air Line, and which has supplied over 90 per cent of the telephone equipment for the 37,000 miles of road which are so covered in the United States.

Lehigh Coal Company's Electrical Project.—Formal application has been made to the Governor of Pennsylvania for charters for about sixty electrical companies in that State by interests identified with the Lehigh Coal & Navigation Company. This is the first step toward carrying out the vast electrical project planned by that company, which was described in detail in the *Electrical World* of March 16. The company proposes to build large steam generating stations adjacent to its coal mines and manufacture energy by the use of dust and screenings that are now wasted. This energy will be distributed through many counties and towns in that section of the State, but under the law it is necessary that a separate local distributing company be organized for each township. When the present plans are fully carried out there will be more than 130 miles of high-tension transmission lines.

Sheridan (Wyo.) Power Plant.—Sanderson & Porter have completed a plant on the Tongue River, about ten miles from Sheridan, Wyo., for the Sheridan Electric Company. A 2000-kw Westinghouse turbo-alternator has been installed together with Le Blanc condensers and Heine boilers. Bituminous lignite is used. The plant will supply lamp and motor service for Sheridan and for various coal mines in the locality. Energy is generated at 2300 volts, transmitted at 22,000 volts and delivered at 2300 volts in substations in Sheridan. The old plant of the Sheridan Electric Light & Power Company, which is succeeded by the Sheridan Electric Company, will be used as a substation. The company is controlled by the Federal Light & Traction Company.

Western Electric Sales.—Sales of Western Electric in March were 10 per cent larger than for the same month a year ago. For the first quarter of its fiscal year to April 1 the company has done 11 per cent more business than in the same period a year ago. For the full twelve months this would mean total sales of $70,000,000 contrasted with $68,375,000 for the thirteen months to Dec. 31 last, or at the rate of $61,000,000 for a twelve months' year. This would mean an increase of about 15 per cent for the year. There has been some letting up in orders in the East, but sales in the Middle and far Western States continue excellent. Western Electric is now employing 25,000 persons, compared with 23,464 on Jan. 1 and 17,835 on Dec. 1, 1909. The present number is within 4000 of the largest payroll the company ever had.

Service on New York Streets Improving.—The monthly reports of defects in the car equipment of the Greater New York surface railways, made to the Public Service Commission, show that conditions are gradually improving and that the number of cars incapacitated is becoming smaller. The report for February shows that the percentage of cars withdrawn on the Brooklyn Rapid Transit was much smaller—in fact, only about half as large—as the smallest percentage shown for Manhattan. This is explained by the engineers of the commission as being due to operation by trolley as compared with underground conduit operation. Fully half of the causes for withdrawal in Manhattan were attributable to the underground connections.

Western Electric Company Transfers Insurance.—The Western Electric Company has transferred $30,000,000 insurance from the mutual companies to stock companies. The greater portion of this covers the company's Clinton Street and Hawthorn works in Chicago. All the insurance for the allied Bell interests, for which the Western Electric makes the telephones, is placed with stock companies. An official of the Western Electric Company made the following statement in connection with the above: "We decided to place our insurance with the Old Line Stock Companies for purely business reasons, the Manufacturers' Mutual Fire Insurance Company having always given us uniform satisfaction."

Detroit United Railways.—Although no settlement has been made in the franchise dispute, officials of the Detroit United Railways have made an agreement with the city officials which will enable the company to add about eight miles of track to the system for the purpose of relieving congestion in parts of the city. Construction cannot be started, however, until this has been ratified by the Municipal Council. The work will be done at the expense of the company, and should the franchise litigation result in municipal ownership the city can take over the extensions at cost, less depreciation.

Moloney Electric Company.—The new factory at Windsor, Ont., of the Moloney Electric Company, of St. Louis, is almost completed and will be in operation within a short time. The company purchased a two-acre plot in Windsor and has constructed a modern plant, which will have 30,000 sq. ft. of floor area. The St. Louis factory has a floor area of 35,000 sq. ft. and has been operated lately at almost full output. The Canadian business of the company has increased so rapidly that the Canadian plant was deemed a necessity.

Citizens' Electric Company (Ark.) Sold.—A company represented by E. F. Ackerman, of Chicago, has purchased the interests of the Citizens' Electric Company, of Eureka Springs, Ark. The company is consolidated with the Eureka Springs Electric Light & Railway Company, and operates a light and power station, street railway, refrigerating plant, the Auditorium Park and Opera House, all of which are included in the sale.

Financial.

The Week in Wall Street.

NO marked change in the dullness of Wall Street trading can be reported for the past week. Such transactions as have been made have barely sufficed to keep the market in motion. At best, these have been manipulation, pure and simple, and cannot be regarded in any light as other than professional movements. For the week only 966,921 shares were sold. The significance of this is seen when it is realized that the week's total sales show only 50 shares more than the sales for the day Feb. 24, the date of the rate decision. Public utilities continue to show a firm tone in spite of depressing conditions. There seems to be a fair demand for investment securities of high grade and for bonds of responsible interests. The postponement of the Standard Oil and American Tobacco decisions is apparently causing less agitation than evidenced a week ago, for Wall Street is inclined to believe that additional influences are affecting the market. The decisions in the price agreement and commodities clause cases are regarded in many quarters as indicative of the rulings to follow in the Sherman law cases. The present stagnation recalls the conditions surrounding the Northern Securities case, but an encouraging note is felt in the comparison of dividends paid in the respective periods. While the average return on a number of stocks showed but 5 per cent during the dullness of 1904, the same securities are now yielding some 5⅛ per cent, and the present earnings are reported as 8¼ per cent, against 6½ per cent in 1904. Considerable interest is taken in the decrease in idle car surplus, which is the first decrease reported since October. Money continues abundant and cheap, which is felt by many to indicate confidence in the future, since an easy money market usually stimulates speculation and general trade. Stocks are held in the majority of cases by large interests and will probably be retained by them until the market becomes more active. Export and crop conditions are fully as encouraging as reported a week ago. Rates for money April 10 were: Call, 2 @ 2⅜ per cent; ninety days, 2¾ @ 3 per cent. The quotations in the table are those for the close, April 10.

NEW YORK.

	April 3.	April 10.	Shares Sold.		April 3.	April 10.	Shares Sold.
All. Ch.....	8*	8*	100	Int. Met., pf. 53	54*		6,400
All. Ch., pf..	30¼	30¼*	200	Mackay Cos..	93½	93½*	150
Amal. Cop..	62⅞	62⅜	9,300	Mackay C. pf.	77*	77*	300
Am. D. T...	20½*	20½*	———	Man. Elev...	136½	137	235
Am. Loco....	37¼	37½	400	Met. St. Ry.	15*	15*	———
Am. Loco. pf.	108	104½	123	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	81*	83*	133	Steel, com...	78	77¼	150,300
Am. T. & T..	144⅞	145¾	7,340	Steel, pfd....	119	119	2,770
B. R. T....	77¾	77⅞	5,550	W. U. T.....	73½*	73	4,200
Gen. Elec...	148	151½	2,900	West'h, com..	66½*	67	600
Int. Met.....	18⅝	19	2,100	West'h, pfd..	120¼	121	310

PHILADELPHIA.

	April 3.	April 10.		April 3.	April 10.
Am. Rys.....	43⅞	44*	Phila. Elec.....	16¼	16¼
Elec. Co. of A.....	12	11⅞	Phila. R. T.....	19½	18⅛
Elec. St. B'ty.....	53½	53	Phila. Trac.....	84	84*
Elec. St. B'ty., pfd..	30*	30*	Union Trac.....	46⅞	46

CHICAGO.

	April 3.	April 10.		April 3.	April 10.
Chi. City Ry.....	185*	186*	Chi. Tel. Co.....	121*	120
Chi. Rs., Ser. 1.....	90*	85*	Met. El. Co.....	22⅞*	22⅛*
Chi. Rs., Ser. 2....	24	23½*	Met. El., pfd.....	69½*	68
Com. Edison.....	128¼	128	Nat'l Car.....	119*	115½
Chi. Subways.....	4⅜	4¾	Nat'l Car, pfd.....	119*	120*

BOSTON.

	April 3.	April 10.		April 3.	April 10.
Am. T. & T.....	144¾	146	Mex. Tel.....	3⅝*	3½
Cum. Tel.....	147*	150*	Mex. Tel., pfd.....	6½*	6½*
Edison E., Ill.....	282	284	N. E. Tel.....	144½*	141*
Gen. Elec.....	148¾	152	W. T. & T.....	20	19½
Mass. E. Ry.....	17½*	17⅛	W. T. & T., pfd....	93½	94
Mass. E. Ry., pfd..	87¾*	88			

*Last price quoted.
Shares sold for week, April 3 to April 8.

Financial Notes.

American Cities Railway & Light Company.—The annual report of the American Cities Railway & Light Company, which operates a number of important properties in Southern cities, shows an increase of $341,352 in the net earnings of the local companies for the year ended Dec. 31, 1910, over the net earnings of the previous year. An increase of $277,560 is noted in the balance for dividends, and there is an increase of $79,516 in the net surplus. The net earnings of the American Cities Railway & Light Company, together with the company's share of the undivided surplus earnings of the local companies, make a total of $1,255,998, as compared with $1,014,178 for 1909. The preferred dividend was 6 per cent. The surplus over preferred dividends is $841,632, which represents 7.82 per cent on the outstanding common stock, against 5.58 per cent in 1909 and 3.38 per cent in 1908. The local companies spent about $1,400,000 during the year on equipment and improvements, about $900,000 of which was provided by the sale of bonds and about $500,000 from surplus earnings. President J. K. Newman said: "The company has had no occasion to borrow either to finance its own requirements or to assist the local companies. The latter have been able to sell bonds for a considerable part of their construction requirements and to care for the balance thereof out of their undivided surplus earnings, except in the case of the Houston Company, where $500,000 new common stock has been sold for cash during the last two years, all of such new stock being purchased by the American Cities Railway & Light Company."

Kings County Electric Light & Power Company Bonds.—The Public Service Commission has authorized the Kings County Electric Light & Power Company to issue $1,500,000 6 per cent debenture bonds. These are the second allowance made on the original request for permission to issue $5,000,000 bonds, the first issue being $2,500,000, as mentioned in these columns March 10, 1910. The new bonds are convertible at par into stock of the company at the option of the holders after three years, and are payable twelve years from date. A condition is made that the bonds must be sold for not less than par and accrued interest. Ths bonds must be offered first to the stockholders, and then to the Brooklyn Edison Investment Fund, which is a pension and profit-sharing plan of the Edison Electric Illuminating Company of Brooklyn. In case the stockholders and the trustees of the fund do not take the entire issue, the balance is to be sold to the highest bidder, in presence of the Public Service Commission. The bonds are to be used to purchase $1,500,000 of non-interest-bearing notes of the Edison Electric Illuminating Company, and the proceeds will be used to pay for improvements and extensions and such advances as the Kings County company has financed for the Brooklyn company.

East Liverpool Traction & Light Company Merger.—In connection with the increase in capital stock of the East Liverpool (Ohio) Traction & Light Company from $10,000 to $1,300,000 and the expected increase in that of the Tri-State Traction Company, of Steubenville, Ohio, it is reported that the former contemplates the erection of a large power station near the Ohio-Pennsylvania State line or at the mouth of Yellow Creek and the Ohio River, and that plans are being formed to bring all traction and lighting interests in the upper Ohio and Beaver valleys under one control. This would include franchises in Beaver Falls, New Brighton, Rochester, Beaver and Ambridge. The East Liverpool Company is a consolidation of the United Power Company, East Liverpool & Rock Springs Railway Company and the Wellsville Electric Light Company, while the Tri-State Traction owns and operates the traction line connecting Steubenville, Ohio, with Follansbee and Wellsburg, W. Va.

Tacoma Municipal Plant.—Brown Brothers & Company, of New York, are offering $650,000 of the 5 per cent gold bonds of the City of Tacoma (Wash.) electric supply fund at 100 and interest. The bonds are issued under the ordinances of the City Council, providing that 40 per cent of the gross earnings of the electric supply system belonging to the city shall be turned into the fund to pay the interest and maturing instalments of the principal. The city charter prohibits the city forever from granting to any person or corporation a franchise to supply energy for light in Tacoma as long as the city owns a plant and is engaged in supplying energy for light. At present the city owns a distribution system 1425 miles in length and is constructing a 32,000-hp hydroelectric plant thirty miles away upon the Nisqually River.

Fort Smith Light & Traction Company.—Announcement is made that the Fort Smith Light & Traction Company, of Fort Smith, Ark., of which Arthur S. Huey is president, has called for payment on May 1 on all of its outstanding consolidated-mortgage 5 per cent gold bonds dated Dec. 15, 1904. The company will redeem these bonds in gold coin, with an addition of 2 per cent premium, at the Chicago office of the Central Trust Company of Illinois on the date mentioned. Thereafter interest on these bonds will cease.

Cuyahoga Telephone Company Notes.—On May 1 the Cuyahoga Telephone Company will buy in $118,800 of its 6 per cent collateral trust notes. These will be paid for in cash by the Cleveland Trust Company.

Public Service Corporation of New Jersey Report.—The annual report of the Public Service Corporation of New Jersey for the year ended Dec. 31, 1910, shows a gross income of $29,205,194 and $14,611,300 in operating expenses and taxes, leaving net earnings of $14,593,894. After deducting fixed charges and bond interest and rentals of leased and controlled companies the net income was $2,200,295. From this $130,000 was set aside as reserve, showing for the year a surplus of $2,070,295. Out of this surplus dividends at the rate of 5 per cent per annum, aggregating $1,250,000, were paid during the year upon the capital stock of the corporation, amounting to $25,000,000 at par. Various improvements and acquisitions have been made during the year, notice of which has appeared in these columns from time to time.

Long Acre Hearing Closed.—The taking of testimony by the Public Service Commission on the application of the Long Acre Electric Light & Power Company for permission to issue $10,000,000 stock and $50,000,000 bonds was concluded April 10. The last witness heard was John W. Lieb, Jr., third vice-president and associate general manager of the New York Edison Company, which has opposed the application. Mr. Lieb put in a written statement in which he declared that his company had "ample capacity, ample reserve and ample margin" for all emergencies and that it would be a bad thing for the public if competition were established.

Kentucky Securities Company.—The stocks and bonds pledged by the Lexington (Ky.) & Interurban Railways Company as collateral for $1,509,000 5 per cent bonds, which were defaulted Feb. 1, were sold in Philadelphia last week to the Kentucky Securities Company for $600,000. The purchaser is a holding concern incorporated last January under the laws of Virginia with an authorized capital stock of $5,000,000. The securities sold represent control of the gas, electric light and ice business of Lexington and surrounding towns. The Lexington & Interurban Railways Company has voted to dissolve.

Berkshire Street Railway Merger.—Plans are being made for the purchase of the Springfield (Mass.) Street Railway Company's system by the Berkshire Street Railway Company, and a bill will shortly go before the Massachusetts Legislature to effect this, stating that the merger shall become operative upon completion of the trolley connection between the Springfield and Berkshire systems. The new company would be known as the Springfield & Berkshire Street Railway Company. The Berkshire company is owned by the New York, New Haven & Hartford Railroad.

Interborough Rapid Transit Notes.—Announcement is made by the Interborough Rapid Transit Company that the $4,584,000 6 per cent notes of the company maturing on May 1, 1911, will be taken up at that time. Information is not given as to the means of raising the money to refund the notes. It may be obtained by the sale of about $5,000,000 of the authorized $55,000,000 5 per cent first mortgage bonds, $20,000,000 of which are now held in the company's treasury. The sale of these bonds would leave $15,000,000 issuable under the $55,000,000 mortgage of 1907.

Telephone Merger Enjoined.—The Federal Telephone Company, of Buffalo, last week secured a temporary injunction restraining the Rochester Telephone Company from selling its stock and property to the Bell interests, represented by the Friendship Telephone Company. The Federal company owns about 35 per cent of the stock of the Rochester company. This injunction will prevent, temporarily at least, the merging of the independent telephone interests with the Bell companies according to the plans heretofore outlined in the *Electrical World*.

Syracuse Lighting Company.—An application has been made to the Public Service Commission of the Second District of New York by the Syracuse Lighting Company asking for authority to issue $470,000 6 per cent bonds, the proceeds to be used for extensions and improvements. If the application is granted almost the entire proceeds will be used for laying new trunk mains and for extensions to the distributing system.

Value of Metropolitan System.—Hearings were reopened last week by the Public Service Commission upon the reorganization plan proposed by the bondholders' committee of the Metropolitan Street Railway Company. These hearings were adjourned several months ago in order that definite figures covering the valuation of the property might be prepared. At last week's hearing the attorney for the reorganization committee presented the report of Charles F. Uebelocker, acting chief engineer of the system, which placed the total reproduction value of the property at $120,562,885. This represented the sum of four items: Reproduction of construction and equipment, $84,108,586; development cost, $18,097,654; net investment in superseded assets, $13,355,645; reorganization assets, approximately $5,000,000. These figures, it was stated, were based on the best evidence obtainable as to what it would cost to-day to purchase the materials and do the work. Frank R. Ford, of Ford, Bacon & Davis, testified that the figures, $18,000,000, for development cost represented 25 per cent of the cost of construction and equipment, which basis, he said, was fully justified by his experience in the examination and appraisal of large street railway properties.

Salisbury & Spencer Railway Company.—Controlling interest in the street railway, electric supply and gas companies of Salisbury, Spencer and Concord, N. C., has been purchased by William J. Oliver, of Knoxville, Tenn. The price was about $1,000,000. This includes the Salisbury & Spencer Railway Company at Salisbury, N. C., which operates an interurban line between Salisbury and Concord, and a line connecting Salisbury and Spencer, where the Southern Railway has several large shops. Energy is purchased from the Southern Power Company. In addition to its traction interests the Salisbury company furnishes gas and electric lighting and controls the Piedmont-Carolina Railway. Extensive improvements will be made by the purchasers.

DIVIDENDS.

American Light & Traction Company, quarterly, preferred, 1½ per cent; common, 2½ per cent in cash and 2½ per cent in common stock; all payable May 1.

Butte Electric & Power Company, quarterly, preferred, 1¼ per cent, payable May 1.

Mexican Lighting & Power Company, quarterly, 1 per cent, payable April 15.

Public Service Investment Company, of Boston, quarterly, preferred, $1.50 per share, payable May 1.

Rio de Janeiro Tramways, Light, Heat & Power Company, quarterly, 1¼ per cent, payable May 1.

United States Rubber Company, quarterly, first preferred, 2 per cent; second preferred, 1½ per cent, payable April 29.

J. G. White & Company, quarterly, preferred, 1½ per cent, payable May 1.

REPORTS OF EARNINGS.

AMERICAN DISTRICT TELEGRAPH COMPANY.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
Year,	1910	$3,894,578	$3,090,832	$803,746	.....	.....
"	1909	3,638,928	2,756,779	882,149	.....	.....

BLACKSTONE VALLEY GAS & ELECTRIC COMPANY.

Feb.,	1911	$98,904	$47,646	$51,258	$30,293	$20,965
"	1910	90,658	41,002	49,656	29,559	20,097

CENTRAL UNION TELEPHONE COMPANY.

Year,	1910	$5,597,240	$4,112,416	$1,484,824	$1,482,947	$1,877
"	1909	4,999,424	3,636,062	1,363,362	1,363,272	90

COLUMBUS ELECTRIC COMPANY.

Feb.,	1911	$37,029	$17,247	$19,782	$9,349	$10,433
"	1910	30,840	16,423	14,417	13,114	1,303

DALLAS ELECTRIC CORPORATION.

Feb.,	1911	$119,965	$76,793	$43,172	$27,064	$16,108
"	1910	105,200	71,960	33,240	26,422	6,818

EL PASO ELECTRIC COMPANY.

Feb.,	1911	$54,850	$31,050	$23,800	$8,341	$15,459
"	1910	53,839	27,753	26,086	8,486	17,600

GALVESTON-HOUSTON ELECTRIC COMPANY.

Feb.,	1911	$99,928	$65,931	$33,997	$24,621	$9,376
"	1910	89,899	61,977	27,922	23,179	4,743

HOUSTON COUNTY ELECTRIC LIGHT COMPANY.

Feb.,	1911	$26,752	$10,858	$15,894	$5,499	$10,395
"	1910	24,954	10,826	14,128	5,100	9,028

JACKSONVILLE ELECTRIC COMPANY.

Feb.,	1911	$46,973	$27,025	$19,948	$10,161	$9,787
"	1910	43,690	22,802	20,888	9,132	11,756

LOWELL ELECTRIC LIGHT CORPORATION.

Feb.,	1911	$42,297	$23,691	$18,606	$4,808	$13,798
"	1910	36,145	18,817	17,328	4,662	12,666

MEXICAN TELEPHONE & TELEGRAPH COMPANY.

Feb.,	1911	$50,529	$25,008	$25,521	.....	.....
"	1910	44,248	19,059	$25,189	.....	.....

NORTHERN TEXAS ELECTRIC COMPANY.

Feb.,	1911	$109,088	$59,820	$49,268	$24,910	$24,358
"	1910	93,082	52,315	40,767	18,252	22,515

PUGET SOUND ELECTRIC RAILWAY.

Feb.,	1911	$132,135	$102,749	$29,386	$53,004	*$23,618
"	1910	131,219	96,882	34,337	50,220	*15,883

SAVANNAH ELECTRIC COMPANY.

Feb.,	1911	$51,300	$32,941	$18,359	$18,352	$7
"	1910	45,130	27,365	17,765	17,752	13

SEATTLE ELECTRIC COMPANY.

Feb.,	1911	$428,557	$246,176	$182,381	$107,171	$75,210
"	1910	431,074	262,708	168,276	111,643	56,633

TAMPA ELECTRIC COMPANY.

Feb.,	1911	$57,335	$28,331	$29,004	$6,282	$22,722
"	1910	56,284	27,256	29,028	4,566	24,462

*Deficit.

General News

Construction News.

BIRMINGHAM, ALA.—Arrangements are being made by the Birmingham & Shades Mountain Electric Railway Company for the construction of an electric railway from Birmingham to Shades Mountain, a distance of four miles. The railway will be built by the High Point Land Company, of which Eugene Fies, of Birmingham, Ala., is president.

GLOBE, ARIZ.—Plans are being considered by the Old Dominion Copper Company for the installation of an extensive electric underground railway system for the purpose of hauling ore from different points in its mine to the surface.

WILCOX, ARIZ.—The construction of a central power plant and transmission system for operating irrigating pumps in the Sulphur Spring Valley is reported to be under consideration. A. I. McAllister, H. A. Morgan, L. V. McCourt, S. N. Kemp and J. W. Angle are interested in the project.

BAKERSFIELD, CAL.—Arrangements are being made by the Lerdo Land Company for the colonization of a large tract of land in Kern County. It is proposed to sink wells and install pumping plants before the land is sold. The transmission lines of the San Joaquin Light & Power Company will be extended through the tract to supply electricity for operating the pumps for irrigation purposes.

BISHOP, CAL.—Preparations are being made by the Owens River Electric Railway Company for the construction of its proposed electric railway to connect Bishop and Laws, four and one-half miles in length, which will be extended to Round Valley, a distance of twelve miles, in the near future. Electricity for operating the railway will be purchased. Harry Shaw, of Bishop, Cal., is president.

EUREKA, CAL.—The Western States Gas & Electric Company, which recently took over the property of the Humboldt Gas & Electric Company, has purchased the plant and holdings of the Arcata Light & Power Company, consisting of a distributing system, pole lines and transformer station. The former company already supplies the Arcata company with energy to operate its system. It is understood that the Western States Gas & Electric Company proposes to secure control of all small electric systems in Humboldt County and is now negotiating for the plants of the Fortuna Lighting Company, of Fortuna, and the Ferndale Light & Power Company, of Ferndale.

FRESNO, CAL.—Notices have been posted by the San Joaquin Light & Power Company that work will begin on the development of its water appropriations within sixty days. Four separate appropriations have been filed aggregating 160,000 in., part of which are below the site of the present power house. The transmission line extending from Crane Valley through Copper Mine and Cornolia to Bakersfield will be completed this summer. The proposed line will carry 60,000 volts. The branch line extending from Linnard to Le Grand into Merced County will be completed in about thirty days.

GRASS VALLEY, CAL.—It is reported that a movement is on foot for the installation of another large water system for Nevada and Placer Counties. According to documents recently filed, James D. Stewart, of Gold Run, Cal., has leased from the United Water & Power Company certain water and mining claims for a period of twenty years, and has also secured an option on 240,000 shares of the company's stock at $75,000. Mr. Stewart has also filed notice of appropriation on five water rights aggregating a total of 355,000 in. of water. It is understood that the property will be developed with a view of building another large water system to provide water for irrigating and other purposes. Besides this, mining claims will be developed and electricity generated at many of the power sites controlled by Mr. Stewart.

LODI, CAL.—Arrangements are being made by the Western States Gas & Electric Company for extending its electric light service to all suburbs of Lodi. The company is also extending a transmission line to the Barnhart tract and will furnish electricity to the Western Normal Institute, which has a generating plant of its own.

LOS ANGELES, CAL.—The Board of Supervisors of Los Angeles County has awarded a franchise to the Eagle Rock Water Company, at its bid of $100, to erect transmission lines for the installation of an ornamental street-lighting system and for commercial lighting.

MACDOEL, CAL.—The California Butte Land Valley Company has entered into a contract with the Siskiyou Electric Power & Light Company to supply electricity for lighting the town of Macdoel, including 8000 hp to be used for operating pumps for irrigation purposes. The service to be ready by July 1.

OAKLAND, CAL.—The Antioch & Oakland Railway Company, which is building an electric railway from Antioch to Oakland, thirty miles in length, has been taken over by the Oakland, Antioch & Eastern Railway Company, recently incorporated with a capital stock of $10,000,000. The railway from Antioch to Oakland is nearly completed and will now be extended to Stockton, which will add another fifty miles to the proposed railway. The directors of the new company are: A. W. Maltby, of Concord; S. L. Naphthaly, Laurence Arnstein, John R. Selby and A. J. Krutmeyer, of San Francisco, Cal.

OROVILLE, CAL.—Harold R. Ebright, of San Francisco, Cal., has deeded to the Oro Water, Light & Power Company water rights aggregating 60,000 in. of water in four creeks flowing into the north fork of the Feather River. The water will be carried in ditches to the site of the proposed power plant near the mouth of Yellow Creek, where it is estimated that about 60,000 hp can be developed. The power house will be located on the opposite bank of the Feather River, about fifty-five miles from Oroville. The company already operates three plants within fifteen miles of Oroville.

QUINCY, CAL.—Notice of appropriation has been filed by W. S. Cone, of San Francisco, Cal., with the County Recorder for 150,000 in. of water of the north fork of the Feather River, to be diverted at a point near Belden Bar, in Plumas County, to be carried to the power house, a distance of about ten miles, by canals and flumes. The water will be used for irrigation, power and domestic purposes in Butte, Yuba, Sutter and other counties. Mr. Cone also recently filed a notice of location of 150,000 in. of water in the north fork to be diverted at or near Big Bar, Butte County.

SACRAMENTO, CAL.—Plans are being prepared by the Pacific Gas & Electric Company for the construction of a steam power auxiliary plant for its Sacramento system. It is understood that the plant will be located on the north side of the city not far from the Southern Pacific Company's railroad shops.

SAN FRANCISCO, CAL.—Options have been obtained on property which it is proposed to use for the site of the power plant for the Geary Street municipal railway.

SEBASTOPOL, CAL.—The plant and holdings of the Sebastopol Light & Power Company have been purchased by the Pacific Gas & Electric Company, of San Francisco, Cal. The Sebastopol company has been purchasing electricity for operating its system from the Pacific Gas & Electric Company. The system was taken over April 1 and will become part of the Santa Rosa division.

SUSANVILLE, CAL.—The Lassen Electric Company has applied to the Board of Trustees for a fifty-year franchise to erect transmission lines for the distribution of electricity for lamps and motors. Bids will be received by the board for the above franchise until April 28. R. E. Baugham is clerk.

WATSONVILLE, CAL.—It is reported that the property of the Watsonville Transportation Company, consisting of power plant, rolling stock, a four-mile track from Watsonville to Monterey Bay, franchise and real estate, has been sold by Edward White, receiver, to J. W. Forgeus, of San Francisco, Cal. The consideration is understood to be $22,000. The new owner, it is said, proposes to rehabilitate the railway in time to handle the apple crop this year.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 3 for two electrically operated floating cranes, complete, one for the United States Navy Yard, Boston, Mass., and the other for the United States Naval Station, Pearl Harbor, Hawaii. Plans and specifications can be obtained on application to the bureau or to the commandant of the navy yard at Boston, Mass., or the naval station at Pearl Harbor, Hawaii. R. C. Hollyday is chief of bureau.

WASHINGTON, D. C.—It is reported that plans are being considered to equip the Chesapeake Beach Railway for electrical operation and extend the railway to Drum Point, a distance of six miles, for which the right-of-way has been graded for several years. The cost of equipping the railway for electrical operation is estimated at from $300,000 to $400,000 and does not include the cost of erecting a power house; the cost of the extension is estimated at about $200,000. Paul W. Waters, 1416 New York Avenue, Washington, D. C., is general manager.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of the District of Columbia, Washington, D. C., until April 25, for furnishing two steam engines and two generators for the McKinley Manual Training School. Forms of proposal, specifications and other information may be obtained upon application to the property clerk of the District of Columbia, Room 820, District Building, Washington, D. C.

JACKSONVILLE, FLA.—Bids will be received by W. M. Bostwick, Jr., chairman of the Board of Trustees Water Works and Improvement Bonds, until April 18 for furnishing six transformers and chimney complete. The Scofield Engineering Company, of Philadelphia, Pa., has charge of the engineering work.

JACKSONVILLE, FLA.—The Board of Bond Trustees have awarded contracts for the new electric plant as follows: For 30-ton electric crane to the Niles-Bement Company, of Philadelphia, Pa., for $4,960; four new boilers, rebuilding four boilers and removal of old ones to the Babcock & Wilcox Company, of New York, N. Y., for $39,384; three condensers for service equipment, complete, and replacing the auxiliaries of two other equipments to the C. H. Wheeler Manufacturing Company,

of Philadelphia, Pa., for $32,950; one feed-water heater to the Warren Webster & Company, of Camden, N. J., for $1,850; two boiler feed pumps and two duplex piston pumps and necessary brass plungers to the Warren Steam Pump Company, of Warren, Mass., for $4,228; and two 1500-kw turbo-generators and two 100-kw turbo exciters to the General Electric Company, of Schenectady, N. Y., for $54,650.

PALATKA, FLA.—A company is being organized for the purpose of constructing an electric railway between Palatka and Summer Haven, twenty miles in length.

ST. PETERSBURG, FLA.—The Pelham Public Utilities Company is contemplating the installation of a 250-kw generator and 350-hp boiler and engine in its plant during the coming summer. The company supplies electrical service and ice in Pelham. William Cook, of Pelham, is manager. The main office of the company is located in St. Petersburg, Fla.

SANFORD, FLA.—It is reported that contracts will be awarded by the Citrus Southern Electric Railway Company for the construction of an electric railway connecting Sanford. Orlando and Kissimmee, forty-five miles in length. T. K. Miller, of Orlando, is president and J. J. Brophy, of Winter Park, is vice-president and engineer.

FAIRBURN, GA.—It is reported that bonds to the amount of $10,000 have been issued, the proceeds to be used for the construction of an electric light plant.

FORT SCREVEN, GA.—Contracts have been awarded for electrical work at Fort Screven as follows: For electric light fixtures and wiring in various buildings to the Sperry Engineering Company, of New York, N. Y., at $7,430, and switchboard, at $2,699; to the F. E. Newberry Electric Company, of St. Louis, Mo., for construction of primary-secondary and street lines, at $7,340, transformers, $1,262, two engines $2,370, steam piping and pump heater, $4,110; to the Ridgway Dynamo & Engine Company of Ridgway, Pa., for two 35-kw, 60-cycle, engine-type alternators, complete with exciters, at $1,980; for boiler and smokestack to E. Keeler Company, of Williamsport, Pa., at $3,131.

CAIRO, ILL.—The Cairo Railway & Light Company is reported to be contemplating improvements to its power plant. H. E. Chubbuck, of Peoria, Ill., is vice-president and general manager.

CHICAGO, ILL.—The contracts for electrical equipment to be installed in the controlling works at Lockport of the Sanitary District of Chicago are reported to have been awarded as follows: To the Crocker-Wheeler Company, of Ampere, N. J., for generator, at $24,900, and to the W. A. Jackson Company for a high-tension transformer, at $16,000.

ROCKFORD, ILL.—Plans are being considered by the Rockford & Interurban Railway Company for the construction of a power plant in Rockford.

SADORUS, ILL.—The directors of the Sadorus Telephone Company are reported to have authorized the construction of a new building, the purchase of a new switchboard and new cable lines.

YORKVILLE, ILL.—It is reported that plans are being prepared by the Fox River Electric Development Company for the construction of a hydroelectric power plant this summer. Bids, it is said, will be received about May 1 for same, which will include four turbines and generators, 22½ miles of transmission line, a masonry dam, 227 ft. long, and the erection of a power station, 90 ft. x 25 ft., which will involve an expentiture of about $75,000. R. S. Simpson is president; Hugh Palmer is engineer in charge, both of Yorkville, and H. B. Hallett, of Aurora, Ill., is consulting engineer.

BEDFORD, IND.—The substation of the Bedford Power Company was put in operation April 5. This station will distribute electricity generated at the Williams plant. Preparations are being made by the company to supply electrical energy to a number of stone quarries in this district as well as to the Bedford Water Works Company.

ELWOOD, IND.—The Elwood Trust Company, receivers for the Citizens' Heat & Light Company, has asked for an order of court to sell the plant. The plant has been idle for some time.

EVANSVILLE, IND.—William McLean, of Henderson, Ky., representing the independent telephone interests in Kentucky, Indiana and Illinois, has filed a petition with the Board of Public Works for a franchise to operate an independent telephone system in Evansville. The applicants agree to give the city 3 per cent of its gross earnings and to expend a large sum in the installation of a new telephone plant.

FARMLAND, IND.—The City Council is reported to have accepted the proposition submitted by E. Goodrich and J. Moorman, of Winchester, Ind., to light the town by electricity for $1,400 per year. It is expected to have the system in operation by Aug. 1.

LAGRANGE, IND.—G. F. Avis, of Hudson, Ind., owner of the local electric-light plant, has purchased water rights in Ontario owned by C. F. Cain. It is understood that Mr. Avis will install additional machinery at the plant in Ontario and transmit electricity to Lagrange for lamps and motors.

LAGRANGE, IND.—It is reported that C. C. Gilhams and Charles Smith, both of Lagrange, have secured options on a dam site located on Pigeon River between Mingo and Ontario which, it is said, they propose to develop, to be utilzed to generate electricity for transmission to Lagrange for lamps and motors.

VINCENNES, IND.—The Southeastern Interurban Railway Company, it is reported, will award contracts for the construction of its proposed electric railway from Vincennes to Jasper as soon as surveys are completed.

JEWELL, IA.—W. H. Grover, of Ames, Ia., is reported to be interested in a project to build an electric light plant in Jewell, work on which will begin in the near future.

KEOKUK, IA.—Steps have been taken to organize a company to build an interurban electric railway from Quincy, Carthage, Nauvoo, Hamilton, Niota, Powellson and Warsaw, Ill. Power for operating the railway will be supplied by the dam now being built across the Mississippi River at Keokuk. Henry E. Dayton, of Quincy, Ill., and Fred Swann, of Nauvoo, Ill., are among the promoters.

MASON CITY, IA.—Preliminary arrangements have been completed by the Forest City & Mason City Railway Company for the construction of its proposed electric railway between Mason City and Forest, thirty miles in length. Contracts for construction of the railway will be awarded May 1.

MORAN, IA.—It is reported that a special election will be held April 18 to vote on the proposition to issue $18,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant and water works system.

PENDLETON, IA.—It is reported that plans are being prepared for the installation of an electric light plant in Pendleton, for which bonds have been voted.

WEBSTER CITY, IA.—It is reported that all bids submitted for furnishing machinery and equipment for the new municipal electric-light plant have been withdrawn under agreement in order to allow the city time to secure more funds. Contract for construction of the power house has already been awarded. The new Council, it is said, may submit a proposition to the voters to authorize an issue of $25,000 in bonds to equip the plant.

GARDEN CITY, KAN.—A petition has been presented to the City Council asking that a special election be called to submit the proposition to issue $20,000 in bonds, the proceeds to be used to purchase or build a municipal electric light plant.

GLASCO, KAN.—At an election held recently the citizens voted to issue bonds, the proceeds to be used for water works and an electric light plant. It is proposed to accept the proposition submitted by the Concordia Electric Light & Power Company to supply electricity from its plant in Concordia to operate the lighting system.

LEAVENWORTH, KAN.—The F. E. Newberry Electric Company, of St. Louis, Mo., has been awarded the contract for installing an electric light and power plant at United States penitentiary hospital, Leavenworth, Kan., at $4,470.

WICHITA, KAN.—Plans are being made by the Wichita Railroad & Light Company for building an extension of its railway system from Wichita to Hutchinson, through Burrton and Halstead.

HOMER, LA.—The Town Council is considering the question of purchasing the local electric-light plant, owned by E. Sawyers, to be owned and operated by the municipality.

BALTIMORE, MD.—Plans have been completed by the Consolidated Gas, Electric Light & Power Company for its new storage-battery plant to be established on McClellan Alley, the cost of which is estimated at from $250,000 to $300,000. Orders have been placed with the Electric Storage Battery Company, of Philadelphia, Pa., for the storage battery. It is expected to have the plant ready for operation by Aug. 15.

FALL RIVER, MASS.—The Fall River Electric Light Company has been granted permission to construct and maintain underground conduits for electric wires on several streets in the city.

READING, MASS.—The question of supplying the town of Wilmington with electricity from the municipal electric light plant is under consideration. Legislation has been enacted permitting the town of Reading to supply such service.

SPRINGFIELD, MASS.—It is announced that the Tariffville branch of the Hartford & Connecticut Western Railroad, eighteen miles in length, connecting Tariffville and Springfield, will be equipped for electrical operation.

WESTFIELD, MASS.—The contract for furnishing cables for the underground conduit system of the municipal electric light and power plant in connection with the Elm Street and Park Square improvements has been awarded to the Safety Insulating Wire & Cable Company, of New York, N. Y., for $11,655.

MARQUETTE, MICH.—The citizens on April 5 voted to issue $100,000 in bonds, the proceeds to be used for the construction of a dam on the Dead River. George W. Rule is secretary of the Light and Power Commission.

BUFFALO, MINN.—J. A. Bonner is reported to have been granted a twenty-year franchise to construct and operate an electric light plant in Buffalo, Minn.

EXCELSIOR, MINN.—Application has been made to the Council by Arndt & Rauchworter, of Belle Plain, Minn., for a franchise to supply electricity in Excelsior.

PROCTOR, MINN.—The village of Proctorknott has granted the Proctor Water, Light & Power Company a franchise to construct and operate an electric-light plant and water-works system in that village for a term of twenty-five years.

TOWER, MINN.—It is reported that bonds to the amount of $16,000 have been voted, the proceeds to be used for the construction of a hydro-electric power plant at Pike River Falls.

TYLERTOWN, MISS.—O. L. Sands, of Tylertown, has applied to the City Council for a twenty-five-year franchise to construct and operate an electric-light plant and water-works system in Tylertown.

BETHANY, MO.—The question of making extensions and improvements to the municipal electric light plant and water-works system is re-reported to be under consideration.

HOLLISTER, MO.—Preparations are being made by the Ozark Water & Power Company for the construction of a large dam across White River, near Hollister, work on which will begin in the near future. The company proposes to build a large power plant and supply electricity to towns within a radius of 100 miles. R. E. Morrison, of St. Louis, Mo., is interested in the project, and W. J. Szwart is chief engineer.

SCOTTSBLUFF, NEB.—The local electric light plant is reported to have been purchased by F. H. Roberts, of Sterling, Col., who has been granted a franchise to operate an electric system in Scottsbluff. Under the terms of the franchise he agrees to install a plant to cost $20,000.

BURLINGTON, N. J.—The City Council has adopted a resolution calling an election to be held April 18 to vote on the proposition to install a municipal electric-light plant in Burlington.

JAMESBURG, N. J.—The Town Council has granted the Jamesburg Electric Company a franchise to supply electricity in Jamesburg.

RED BANK, N. J.—The Board of Public Utilities is reported to have approved of the consolidation of the Shore Electric Company, of Red Bank, N. J.; the Seabright Electric Light Company, of Seabright, N. J., and the Citizens' Light & Fuel Company, of South Amboy, N. J., under the name of the Shore Lighting Company. The new company will be capitalized at $112,000 and will issue bonds to the amount of $400,000, the proceeds to be used to take up outstanding bonds of the old companies and for the completion of the new plant at Red Bank and for other improvements to the three properties.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company is reported to be considering the erection of new elevated lines to tap the Hunter's Point, Greenpoint and Bushwick sections, and to connect these districts with Borough Hall, Brooklyn, and with Manhattan.

BROOKLYN, N.Y.—It is understood that the Drum Elevator Company, 103 Walker Street, New York, N. Y., which is contemplating the construction of a new plant on Sands Street, Brooklyn, N. Y., will require new equipment for its factory. The company has not yet decided whether it will use steam or electricity for motive power.

BROOKLYN, N. Y.—The Public Service Commission, First District, has granted the Kings County Electric Light & Power Company authority to issue $1,500,000 in bonds, the proceeds to be used to reimburse the Edison Electric Illuminating Company for expenditures for improvements and betterments made to its system.

ELMIRA, N. Y.—The plant of the Hatfield Manufacturing Company, has been moved from Cornwall, N. Y., to Elmira. It is understood that the company will install some new machinery, including power equipment, and it may use electric motors. W. N. Taylor is general manager.

JOHNSTOWN, N. Y.—Plans are being made to organize a company to construct and operate an electric railway from Little Falls to Johnstown. The proposed railway will connect with the Fonda, Johnstown & Gloversville system at Johnstown. J. J. Gilbert, L. O. Bucklin, F. G. Tealle and H. P. Snyder, of Little Falls, and F. G. Engelhardt, of St. Johnsville, and others are interested in the enterprise.

KATONAH, N. Y.—The Katonah Light Company has been authorized by the Public Service Commission, Second District, to exercise its franchise privileges granted by the town of Lewisboro for the extension of its electric-lighting service to that town. The company was also granted permission to issue capital stock to the amount of $45,000, the proceeds to be used for extensions and improvements to its plant.

NEWBURGH, N. Y.—The Newburgh Light, Heat & Power Company is contemplating the construction of a power plant in Balmville, near Newburgh, plans for which have been prepared by Frank E. Estabrook, engineer.

NEW YORK, N. Y.—The Treasury Department has awarded the contract for an electric elevator equipment for the new post office building in New York, N. Y., to the Otis Elevator Company, of New York, for $139,450.

SYRACUSE, N. Y.—The Syracuse Lighting Company, of Syracuse, N. Y., has applied to the Public Service Commission, Second District, for permission to issue $470,000 in bonds, of which the proceeds of $147,800 will be used in the electrical department to extend its transmission lines into districts not now reached by exitsing lines; a new frequency changer will be installed at a cost of $27,000 and other improvements made.

WADDINGTON, N. Y.—Announcement has been made by J. Wesley Allison, vice-president and general manager of the New York & Ontario Power Company, that the contract between the company and the Hydro-electric Power Commission of the Province of Ontario has been signed, under the terms of which the company is to supply electrical energy to the eastern municipalities in Ontario to the amount of 15,000 hp. The towns included are Prescott, Brockville, Lyn, Lansdowne, Napanee, Kingston, Cardinal, Morrisburg and Athens. Under the terms of the contract the power must be available within a year. The main transmission line will be extended to Ogdensburg, at which point it will cross the St. Lawrence River. Work on completion of the plant will be pushed rapidly. W. S. Connelly, of Hamilton, Ont., is president.

WAVERLY, N. Y.—Preparations are being made by the Elmira, Corning & Waverly Railway Company for the construction of a substation to be erected at Big Flats, work on which will begin in the near future. Electricity for the new substation will be supplied by the local power plant.

YONKERS, N. Y.—Bids will be received by John H. Claxton, secretary Board of Education, until April 14 for power transmission apparatus for the Saunders Trades School, now under construction. Bids will also be received until May 1 for other specified machinery for the school. The cost of the whole outfit is estimated at $20,000.

DURHAM, N. C.—The Southern Power Company is reported to have purchased a site in Durham, on which it will erect an auxiliary steam plant to supply electricity in Durham and vicinity. The proposed plant will have an output of about 10,000 hp.

SALISBURY, N. C.—It is reported that negotiations have been closed whereby 51 per cent of the capital stock of the street railway, electric light and gas companies of Salisbury, Concord and Spencer, N. C., has been purchased by William J. Oliver, of Knoxville, Tenn., involving $1,000,000. The deal also includes an electric interurban railway, connecting Salisbury and Concord, twenty-one miles in length, and the railway connecting Salisbury and Spencer. It is understood that Mr. Oliver will make extensive improvements to the properties.

GLEN ULLIN, N. D.—The installation of an electric-light plant in Glen Ullin is reported to be under consideration.

CLEVELAND, OHIO.—The Williams Edwards Company, it is reported, will soon place orders for equipment for power plant for its new building now under construction. The present plans call for two 200-hp water-tube boilers, two generating units and complete electric and elevator equipment.

COLUMBUS, OHIO.—The City Council is considering a resolution to submit a proposition to issue $250,000 in bonds, the proceeds to be used to equip the municipal electric light plant to supply electricity, to a vote of the people at an election to be held May 31.

NELSONVILLE, OHIO.—The citizens on April 1 voted to issue $16,000 in bonds, the proceeds to be used for improvements to the municipal electric-light plant.

WILLOUGHBY, OHIO.—The Cleveland, Painesville & Eastern Railroad Company is reported to be contemplating increasing the output of its power house at Willoughby. The equipment to be installed will include two boilers and electrical apparatus.

SENTINEL, OKLA.—At an election held recently the citizens voted to issue $12,000 in bonds for the construction of a municipal electric-light plant. F. Murch, of Clinton, Okla., is engineer in charge.

CANBY, ORE.—Work has commenced on the construction of an electric railway from Canby to Mollalla, a distance of twenty miles, with branch lines leading to Beaver Creek, Meadow Brook, Colton, Needey and McBurgh. A site has been secured on the Willamette River, two miles from Canby, on which a power station will be erected.

MEDFORD, ORE.—Contracts have been awarded by the Rogue River Electric Company for the equipment for its proposed new power plant at Prospect. The equipment includes a large waterwheel and three turbines. When the new plant is completed the present plant at Gold Bay will be used for auxiliary purposes only.

NEWPORT, ORE.—The plant and holdings of the Newport Power Company are reported to have been sold to Henry Hewitt, J. J. Hewitt and Seymour H. Bell. The system will hereafter be operated under the name of the Yaquima Electric Company. The plant will be reconstructed. The work will include the installation of new equipment, new power house and new wiring system in the city and extension of lines to surrounding towns and cities. The company contemplates an expenditure of about $30,000.

PORTLAND, ORE.—The City Council has granted the Mount Hood Railway & Power Company a franchise to supply electricity in Portland for a period of twenty-five years. Under the terms of the franchise the company is to pay the city 2½ per cent of the gross revenue derived from the sale of electricity within the city limits and 1½ per cent to outside points when electricity for such is transmitted through the city. In order to prevent a merger between the Mount Hood company and competing companies, a provision in the franchise stipulates that the company must pay to the city 25 per cent of the gross revenue derived from electricity sold to companies generating electricity. The installation of the first unit of the company will involve an expenditure of about $3,000,000. About five miles of transmission lines have been erected and the company expects to be ready to deliver power contracted for by May 1, when the auxiliary steam plant near St. Johns will be ready to supply about 4000 hp.

SALEM, ORE.—It is understood that the Kingwood Park Light & Water Company will obtain electricity for operating its system from the Portland Railway, Light & Power Company. The Kingwood Park company, it is said, will erect a transmission line across the river at Kingwood Park to connect with the power lines of the Portland Railway, Light & Power Company.

HARRISBURG, PA.—A bill has been introduced in the Senate by Senator McNichols, of Lackawanna, which would compel all water com-

panies which furnish power for manufacturing purposes to furnish such power for public purposes.

LOST CREEK, PA.—The capital stock of the Lost Creek Valley Rural Telephone Company has been increased from $5,000 to $25,000.

STEELTON, PA.—The Steelton Light, Heat & Power Company has increased its capital stock from $60,000 to $100,000.

PHILADELPHIA, PA.—Arrangements are being made by Alexander Brothers for enlarging their plant. A contract has been awarded to G. F. Pawling & Company for the erection of a steel, brick and concrete building, 71 ft. x 178 ft., extending from 414-416 North Fourth Street through to Orinna Street. Plans are also being considered for enlarging the power plant, which will probably double the present output.

PHILADELPHIA, PA.—Work has begun on the construction of the large manufacturing plant to be erected by the Hohlfield Manufacturing Company at Tenth Street and Sedgley Avenue. The group will include three buildings. The present plant, located at Eighth and Dauphin Streets, will be removed to the new factory when completed. The company has not yet decided whether to install a steam or electric plant. It is understood that both are under consideration.

PLYMOUTH, PA.—Proposals will be received at the office of John Love, secretary of Plymouth Township, Plymouth, Pa., until April 24 for lighting the streets of the town with twenty or more arc lamps for terms of five, seven and ten years.

SUMNEYTOWN, PA.—James S. Miller is reported to be contemplating the construction of an electric light plant in Sumneytown. The plant will supply electricity for lamps in Sumneytown and surrounding villages.

CEBU, P. I.—The Visayan Electric Company is planning to install a 240-hp engine and a 225-kw, two-phase, alternating-current generator. The 100-kw unit now in the plant will be used for the day service. Albert Bryan is president and manager.

LEXINGTON, S. C.—At an election held recently the citizens voted to grant the Lexington Electric Light & Power Company an exclusive franchise to supply electricity in Lexington. The company will begin work on the plant at once. W. W. Barr is president.

FAITH, R. F. D., LEMMONVILLE, S. D.—The Faith Light & Power Company is reported to have been granted a franchise to install an electric light plant in Faith.

LANGFORD, S. D.—The C. B. Hersey Company is reported to have been granted a franchise to install an electric light plant in Langford, S. D.

BRISTOL, TENN.—The Bristol Belt Line Railway Company is contemplating equipping the railway from Bristol to Big Creek Park, ten miles in length, for electrical operation.

HENDERSON, TENN.—Plans are being considered for the construction of an electric railway to extend from Henderson or Jackson and run east to some point on the Tennessee River, thence up the river to Savannah.

MEMPHIS, TENN.—The City Commission has adopted a resolution to ask the Legislature to authorize the City of Memphis to issue bonds, the amount to be specified later, for the construction of a municipal electric light plant. The city is paying at present from $130,000 to $140,000 per annum for lighting the municipality.

BELTON, TEX.—The Commercial Club, of Belton, is reported to be interested in a project to build an interurban electric railway from Belton to Holland, a distance of sixteen miles.

EL PASO, TEX.—The board of governors of the Elephant Water Users' Association and the El Paso Valley Water Users' Association has decided that the hydroelectric feature of the Elephant Butte Dam and the reclamation project in New Mexico shall be developed by the federal government instead of a private power company. Steps have been taken by the government to install a temporary electric power plant on the site of the dam at Elephant Butte, N. M., at a cost of about $500,000. O. H. Ensign, chief electrical engineer of the reclamation service, has charge of the hydroelectric part of the project.

HOUSTON, TEX.—The First National Bank has awarded a contract to the Barden Electric & Machinery Company for the installation of a power plant for its new building.

PALESTINE, TEX.—Plans are being prepared by the Trinity Valley Traction Company for the construction of an electric interurban railway between Dallas and Palestine, via Waxahachie and Corsicana, a distance of 110 miles. The cost of the road and equipment is estimated at about $3,000,000. The company expects to be in the market during the summer and fall for material for same. The general offices of the company are located at Dallas, Tex. J. V. Watkins is president.

SHERMAN, TEX.—Bids will be received by the Superintendent of Water Works, Sherman, Tex., until May 1 for the following equipment: Two deep wells, internal-combustion engine, gas producer, air compressor, electric generator, motors, switchboards and power-driven pump. Specifications are on file in the office of Barney C. Kreager, city secretary.

TYLER, TEX.—The Gulf States Telephone Company, of Doven, Del., has been granted a permit to do business in Texas with headquarters at Tyler. The company is capitalized at $250,000 and proposes to erect a telephone line through the eastern part of Texas running into McLennan County.

WICHITA FALLS, TEX.—The City Council has granted a franchise to another electric-light company in Wichita Falls. The franchise provides for a maximum rate of 11 cents per kw-hour for consumers using less than 50 kw per month, with a discount of 10 per cent if paid within ten days, with a minimum annual charge of $12. To consumers using more than 50 kw per month the rate will be 7 cents per kw-hour. The company will begin work immediately on construction of a plant.

LOGAN, UTAH.—The Cache County Amusement Company is making arrangements for the construction of an electric railway to connect Preston, Idaho, Franklin, Richmond, Lewiston, Smithfield, Hyde Park, Greenville, Logan, Providence, Millville, Hyrum, Wellsville and Paradise, fifty miles in length, work on which will begin about July 1. No contracts have been awarded as yet. The power station and repair shops will be located in Logan. Job White, of Salt Lake City, Utah, is president.

NEWPORT NEWS, VA.—The State Corporation Commission has issued an order to the Newport News & Old Point Railway & Electric Company to put its plant in repair within thirty days and that the entire plant must be completely renovated within four months. Both the traction and lighting service of the company is inadequate to meet the demands made upon it.

PETERSBURG, VA.—The special committee appointed by the City Council to look into the matter of establishing a municipal electric light plant has decided that it is not prepared to make a final report and has recommended that a sub-committee be appointed to make a full investigation as to the cost and maintenance of such a plant. It is estimated that a plant of sufficient output to provide the service required would cost from $300,000 to $400,000. The city now pays the Virginia Railway & Power Company $16,000 per year for lighting the city.

RICHMOND, VA.—The citizens of Highland Park have voted to issue additional bonds to the amount of $50,000, the proceeds to be used for the completion of water works and sewer systems, additional street lamps and other improvements.

RICHMOND, VA.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until May 8, for the installation of conduit, wiring and lighting system in connection with the reconstruction of the United States post office, court house and custom house building at Richmond, Va., in accordance with plans and specifications, copies of which may be obtained at the above office or from the office of the superintendent of construction at Richmond. James Knox Taylor is Supervising Architect.

WINONA, WASH.—M. W. Fockler, of Winona, is reported to have purchased a site about one mile west of Winona, on which he proposes to erect a power house. Electricity generated at this plant will be transmitted to Endicotte, Lacrosse and Winona.

RONDA, W. VA.—The power plant on Cabin Creek of the Coalburg Colliery Company is reported to have been destroyed by fire recently, causing a loss of about $10,000.

WELLSBURG, W. VA.—The plant and holdings of the Wellsburg Light & Power Company have been purchased by the Ohio Valley Scenic Company. The consideration is said to be from $20,000 to $25,000.

ALTOONA, WIS.—The Chippewa Valley Railway, Light & Power Company, of Eau Claire, Wis., is reported to have applied to the City Council for a franchise to construct and operate an electric railway in Altoona.

BARABOO, WIS.—At an election held April 4 it is reported that the citizens voted to issue $45,000 in bonds, the proceeds to be used for the installation of a municipal electric-light plant.

BROOKLYN, WIS.—It is reported that the proposition to issue bonds for the construction of a municipal electric plant in Brooklyn will be submitted to a vote of the people.

JIM FALLS, WIS.—It is reported that H. M. Byllesby & Company, of Chicago, Ill., have secured an option on the new dam at Jim Falls. It is understood that the company proposes to transmit electricity generated at the dam to Minneapolis and St. Paul, Minn.

KENOSHA, WIS.—Governor McGovern has signed the bill providing for the validation of the franchise of the Kenosha Electric Railway Company to supply electricity for lighting in Kenosha. Owing to the company having failed to comply with the demands of the Wisconsin Railway Commission the courts had pronounced the franchise void.

LA CROSSE, WIS.—M. W. Fockler, of Winona, Wis., is reported to be interested in a project to install an electric plant to supply electricity for lamps and motors in Endicott, Winona and La Crosse.

SOMERSET, WIS.—The hydroelectric power plant of the St. Croix Power Company at Apple River Falls is reported to have been damaged by fire recently, causing a loss of about $5,000.

PORTAGE LA PRAIRIE, MAN., CAN.—The City Council has appointed a committee, consisting of Mayor Garland, Aldermen Charles Sharpe and Sweet, to look into the proposition submitted by the City of Winnipeg to supply electricity in Portage La Prairie generated at the Winnipeg municipal hydroelectric power plant at Point du Bois.

MONCTON, N. B., CAN.—The Moncton Tramways, Electric & Gas Company is reported to have purchased the municipal electric-light plant. It is understood that work will begin on the construction of the street railway and the installation of a natural gas supply as soon as the frost is out of the ground.

DARTMOUTH, N. S., CAN.—A. C. Pyke and Robert Stanford are reported to be interested in a project to build an electric railway in Dart-

mouth out to Cow Bay, for which application for a charter will be made.

LUNENBURG, N. S., CAN.—Owing to a disagreement between the Council and Lunenberg Gas Company, the street-lighting service has been discontinued. The Council refused to pay the rate demanded by the company for electric street lamps. It is expected that the matter will be referred to the Public Utilities Commission.

BOWMANVILLE, ONT., CAN.—At an election held April 4 the ratepayers voted in favor of the by-law authorizing the sale of the municipal electric-light plant and franchise to the Seymour Light & Power Company for the sum of $16,000. A by-law was also passed granting the company a fixed assessment of $5,000 for ten years.

BROCKVILLE, ONT., CAN.—At a meeting of representatives of nineteen municipalities held April 7 at Brockville for the purpose of considering the question of securing electricity through the Hydro-Electric Power Commission, announcement was made by Adam Beck, chairman of the commission, that a contract has been entered into with the New York & Ontario Power Company, of Waddington, N. Y., with the option of securing 15,900 hp at a total cost of $657,000. In addition, a proposition has been submitted by M. F. Beach, owner of water rights at High Falls, which would cover the eastern portion of the province, with a distributing station at Kingston. The schedule of rates for municipalities forming the union in eastern Ontario is as follows: Kingston, 1200 hp at $29.45 per hp; rate per hp provided 50 per cent additional is taken, $23.76, and $15.20 per hp provided 100 per cent additional is taken. Napanee, 200 hp, $36.23 per hp; for 50 per cent additional, $28.44 per hp, and $22.09 per hp for 100 per cent additional. Lansdowne, 100 hp, $55.38 per hp; for 50 per cent additional, $34.13 per hp, and $26.81 per hp for 100 per cent additional. Brockville, 100 hp, $20.40 per hp; for 50 per cent additional, $17.49 per hp, and $15.37 per hp for 100 per cent additional. Lyn, 100 hp, $22.43 per hp; for 50 per cent additional, $18.83 per hp, and $16.31 per hp for 100 per cent additional. Prescott, 500 hp for $18.17 per hp; for 50 per cent additional, $15.86 per hp, and $13.50 per hp for 100 per cent additional. Cardinal, 100 hp. $18.18 per hp; for 50 per cent additional, $14.50 per hp, and $12.90 per hp for 100 per cent additional. Morrisburg, 2000 hp, $16.18 per hp; for 50 per cent additional, $12.03 per hp, and $11.67 per hp for 100 per cent additional. Athens, for 75 hp, $30.07 per hp; for 50 per cent additional, $30.05 per hp, and $24.60 per hp for 100 per cent additional. The contract is to run for ten years, with option of continuing for one, two or three similar periods, provided three months' notice is given before the expiration of the first ten years.

FORT WILLIAM, ONT., CAN.—The Grand Trunk Railroad Company is reported to be making investigations on State River with a view of locating a power dam on the river. E. J. Chamberlain, of Winnipeg, Man., Can., is general manager.

PETROLIA, ONT., CAN.—Owing to the Town Council refusing to accept the terms offered by the Petrolia Light, Heat & Power Company for lighting the streets of the town, the company discontinued the service on April 5. The town has applied to the Public Utilities Commission to look into the matter, as the officials claim that the company is charging excessive rates.

RENFREW, ONT., CAN.—Preparations are being made for the construction of a municipal electric light plant and water-works system, for which bonds to the amount of $117,000 have been issued. J. R. Stewart, of Renfrew, Ont., is engineer in charge.

STRATFORD, ONT., CAN.—Electricity for operating the municipal electric-light system is now supplied by the Hydro-Electric Power Commission's transmission line to western Ontario. The steam plant was closed down April 6, but will be held in reserve for use in emergencies.

STURGEON, ONT., CAN.—The report submitted to the Council for the installation of an electric-light plant and water-works system estimates the cost at $50,000. As funds are not available at the present time for this purpose, the Council is considering the question of arranging with a private company to erect a pumping station, the city to have the option of purchasing the plant when practicable.

TORONTO, ONT., CAN.—The board of directors of the Toronto Electric Light Company has rejected the offer of the City of Toronto to purchase the property of the company at $125 per share. The board voted to recommend to the stockholders to accept an offer made on behalf of Sir William McKenzie, president of the Toronto Railway Company, to purchase the stock of the Toronto Electric Company at $135 per share.

TORONTO, ONT., CAN.—The Ontario government has approved the plans of the Hydroelectric Power Commission for the extension of the St. Thomas transmission line to Windsor, to cost approximately $2,000,000. The proposed line will be 128 miles long and will supply electrical energy to twenty-three municipalities along the line. The extension will depend on whether favorable contracts can be made with Windsor for distributing electricity elsewhere. In order to secure the extension the City of Windsor must contract for 15,000 hp, and as only 2000 hp will be used within the city a market must be found outside of Windsor for the remainder.

TORONTO, ONT., CAN.—The special committee appointed by the City Council on subway railroads has decided to ask the City Engineer to prepare plans and specifications for the construction of a subway to admit traffic on Yonge Street from Union Station to St. Clair Avenue, a distance of about three miles. Tenders will be asked on these specifications and the most acceptable proposition will be submitted to a vote at the municipal election next January in a by-law asking for an appropriation to build the same. H. C. Hocken, chairman of the committee, states that three radial railways would use the subway if built. The committee will ask for an appropriation of $5,000 to pay for the cost of preparing preliminary plans and specifications for the subway.

WINDSOR, ONT., CAN.—It is reported that the local distributing company at Windsor has practically closed negotiations with the Michigan Central Railway Company for a large block of electrical energy for use in the Detroit River Tunnel. The Edison Company, of Detroit, Mich., is now furnishing electricity to the tunnel company under a ten-year contract, which, it is said, is not exclusive. The power now being used represents but a small portion of what will be required by the Michigan Railway Company.

REGINA, SASK., CAN.—Tenders will be received by S. P. Porter, Department Minister Railways, Telegraphs and Telephones, Regina, Sask., Can., for construction of the following telephone lines: Moose Jaw-Swift Current, Saskatoon-Battleford, Saskatoon-Biggar, Abernathy-Strassburg and Wolseley-Windthorst.

New Industrial Companies.

THE ALLIED SAFETY DEVICES COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $10,000 by George B. Hinkley, George B. Nye and George E. Houck, all of Buffalo, N. Y. The company proposes to manufacture apparatus to protect machinery operators and workmen.

THE AMERICAN STEEL MANUFACTURING COMPANY, of Jersey City, N. J., has been incorporated by H. W. Andrews, E. Madden and G. Cohen, of New York, N. Y. The company is capitalized at $125,000 and proposes to do a general electrical, mechanical and civil engineering business, etc.

THE BENTLEY-SNYDER COMPANY, of Chicago, Ill., has been chartered by Wilton Bentley, Frederick T. Snyder and James V. Cunningham. The company is capitalized at $8,000 and proposes to manufacture and deal in metals, electricity and electric furnace products.

THE BROZELLE, MOTOR COMPANY, of St. Louis, Mo., has been chartered, with a capital stock of $10,000, and proposes to manufacture engines and motors. The incorporators are: Benjamin Brozelle, D. M. Houser, Charles McKee and others.

THE ECONOMY ELECTRIC SUPPLY COMPANY, 335 Monadnock Building, Chicago, Ill., has been incorporated to deal in electrical supplies and specialties. The new company will make a feature of importing tungsten lamps and other electrical goods from Germany and elsewhere. Wallace Kirk, formerly connected with the Sanitary District of Chicago, is president; Robert W. Means is treasurer, and T. B. Hemmick sales manager. Mr. Hemmick was formerly connected with the Pittsburgh Electrical Supply Company. Robert R. McCormick, Potter Palmer, Jr., and A. A. Sprague, 2d, are among the stockholders.

THE ELECTRIC CONTROLLER COMPANY, of Oklahoma City, Okla., has been incorporated with a capital stock of $100,000 by C. O. Alle, W. M. Bowles, of Shawnee, Okla.; Milton Bryan, J. M. Postelle and Abner Davis, of Oklahoma City, Okla.

THE ELECTRIC FURNACE COMPANY, of Alliance, Ohio, has filed articles of incorporation with a capital stock of $20,000. The incorporators are: T. F. Bailey and others.

THE ELECTRIC VEHICLE COMPANY, of St. Louis, Mo., has been incorporated by Lee Miles, Edward Drummond, of the Drummond Manufacturing Company: Philip Allison and H. B. Hewett, of the Cooper Hewitt Company, of Louisville, Ky. The company is capitalized at $10,000. and proposes to manufacture electric passenger and commercial automobiles.

THE FOXWORTHY ELECTRIC COMPANY, of Indianapolis, Ind., has been incorporated by M. K. and E. H. Foxworthy and L. R. Miller. The company proposes to manufacture and deal in electric devices and supplies of all kinds.

THE D. GORDON ELECTRIC COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $25,000 for the purpose of manufacturing electrical appliances. The incorporators are: Isaac B. Lipson, Morris K. Levinson and Sylvanus G. Levy.

THE HUDSON METALLIC MANUFACTURING COMPANY, of Ossining, N. Y., has been granted a charter with a capital stock of $10,000 for the purpose of manufacturing metal goods, electrical supplies, etc. The incorporators are: Robert M. Akin, Joseph Royle and William O. Higgins, all of Ossining, N. Y.

THE ILLINOIS CONTRACTING ELECTRICAL COMPANY, of Rock Island, Ill., has filed articles of incorporation with a capital stock of $7,000 for the purpose of doing a general manufacturing business. The incorporators are: W. W. Wilmerton, Martin McNealy and Frank H. Kelly.

THE L. H. L. IGNITION COMPANY, of New York, N. Y., has been incorporated with a capital stock of $250,000 by J. H. Lehman, A. T. Otto and C. M. Lowther, of New York, N. Y. The company proposes to manufacture electrical apparatus, etc.

THE NEW YORK ELECTRO-PNEUMATIC TOOL COMPANY, of

Ridgewood, N. J., has been incorporated by J. J. Roberts, W. W. Wilsey and L. D. Forman, of Ridgewood, N. J. The company is capitalized at $300,000, and proposes to manufacture foundry, factory and mill supplies.

THE SERVICE MOTOR CAR COMPANY, of Wabash, Ind., has been incorporated by C. S. Reiman, B. F. Reiman and E. A. Bullock. The company is capitalized at $500,000 and proposes to manufacture gasoline and electric vehicles and supplies.

New Incorporations.

JONESBORO, ARK.—Articles of incorporation have been filed for the Spring River Power Company with a capital stock of $100,000. The officers are: F. R. Lang, president; J. D. Browne, vice-president; William Henry Vaughn, secretary, and James E. Parr, treasurer. The company owns large holdings in and around Mammoth Springs, Imboden and other points, and proposes to supply electricity for various plants in this vicinity.

MODESTO, CAL.—The Turlock Traction Company has been incorporated with a capital stock of $500,000 by S. N. Griffiths, of Fresno, Cal.; A. M. Morton, Lloyd Griffiths, A. C. Chatom and D. R. Shafer, of Turlock, Cal. The company proposes to construct an electric railway between Turlock and Denair, four miles in length.

SAN FRANCISCO, CAL.—The Municipal Light & Power Company has been incorporated with a capital stock of $1,000,000 and the following directors: P. S. Scales, of San Mateo, Cal.; J. H. Sanford, Rudolph Spreckels, of San Francisco, Cal.; Frank Harrold, of Fruitvale, Cal., and Claus A. Spreckels, of New York, N. Y. It is understood that the company is a reorganization of the Municipal Light & Power Company, which was operated for several years as part of the Spreckels estate. The present plant is to be enlarged and the system extended as rapidly as possible. The company is to supply both gas and electric service.

DOVER, DEL.—The Western States Gas & Electric Company has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $15,000,000. The incorporators are: G. Graweig, H. H. Darling and W. C. McKenna, of Chicago, Ill.

ATLANTA, GA.—The Austell Power Company has been granted a charter with a capital stock of $300,000 with the privilege of increasing the amount to $1,000,000. The company proposes to develop and operate power plants, and it is understood that it has several locations in view convenient to Atlanta. The incorporators are: C. C. Bruckner, George W. Mason, of Atlanta, and George E. Zimmerman, of New York, N. Y.

LITTLE YORK, ILL.—Articles of incorporation have been filed for the Little York Telephone Company with a capital stock of $5,000 by Willis Wiley, C. W. Cooper and J. R. Porter.

NOBLESVILLE, IND.—The Prairie Telephone Company has been incorporated with a capital stock of $10,000 by Jacob M. McDonald, Williams Wales, Charles S. Snyder and O. V. Snyder. The company proposes to operate a telephone system in Hamilton County.

MAYSVILLE, KY.—The Maysville Public Service Company has applied for a charter to build an electric railway in Maysville. The company is to be capitalized at $150,000. The incorporators are: A. M. J. Cochran, R. A. Cochran, W. H. Cox, H. Fichlin and Samuel Hall, of Maysville.

KANSAS CITY, MO.—The Kansas City, Clay County & St. Joseph Railway Company has been incorporated with a capital stock of $720,000 for the purpose of building a railway from Kansas City to St. Joseph, with a branch to Excelsior Springs. The motive power will be either steam or electricity. The incorporators are: George Townsend, George D. Beardsley, William A. Medill and Grant Peabody, of Kansas City, Mo., and Ward S. Arnold, of Chicago, Ill.

PEGGS, OKLA.—Articles of incorporation have been filed for the Spring Creek Telephone Company by C. W. Bradshaw, C. A. Downing, C. A. Wilson, D. A. Robinson and Tilman England. The company is capitalized at $2,000.

LOCK HAVEN, PA.—The Lock Haven & Jersey Shore Railway Company has filed articles of incorporation for the purpose of constructing an electric railway to connect Lock Haven and Jersey Shore, via Dunstable, Pine Creek, Charlton, Woolrich and Avis.

PORTLAND, PA.—Articles of incorporation have been filed for the Water Gap & Portland Street Railway Company with a capital stock of $24,000. The directors are: B. F. Dillard, of East Bangor, Pa., president; William Bray, Joshua Bray, of East Bangor, Pa.; J. I. Johnson, of Portland, Pa., and George Raesly, of Mt. Bethel, Pa.

POTTSGROVE, PA.—Charters have been granted by the Secretary of State to the Suburban Electric Company of Upper Pottsgrove, the Suburban Electric Company of Lower Pottsgrove and the Suburban Electric Company of West Pottsgrove. Each company is capitalized at $5,000 and the incorporators are: Dr. William J. Ashenfelter, of Pottstown, Pa., treasurer; William R. Shuler and Livingston Saylor, all of Pottstown, Pa.

TITUSVILLE, PA.—The Titusville Light & Power Company has been incorporated with a capital stock of $5,000. The directors are: William J. Seltzer, of Philadelphia, Pa., treasurer; Charles C. Aeugle, J. Ross Burhouse, both of Philadelphia, Pa.

SUMTER, S. C.—The Sumter Lighting Company has been incorporated with a capital stock of $200,000 by I. C. Strauss and E. H. Moses.

ALPINE, TEX.—The Alpine Telephone Company has been incorporated with a capital stock of $15,000 by J. E. Mills, W. F. McCaughey and R. T. Burks.

BARRY, TEX.—The Vest Telephone Company has been chartered with a capital stock of $20,000 by D. W. Vest, H. W. Denton, A. H. Elnore and others.

BELTON, TEX.—Articles of incorporation have been filed for the Belton Ice & Electric Company with a capital stock of $75,000 by W. W. Thornton, N. K. Smith and M. V. Smith.

DALLAS, TEX.—Articles of incorporation have been filed for the Dallas Street Railway Company with a capital stock of $20,000 to construct and operate an electric railway in Dallas to connect at Garrett Avenue and Ross Avenue with the Dallas Consolidated Electric Street Railway, thence eastward on Ross Avenue to Henderson Avenue and north to the city limits. The incorporators are: George W. Works and W. Leslie Williams.

WESTFIELD, VT.—Articles of incorporation have been filed for the Missiquo Telephone Company with a capital stock of $10,000 for the purpose of acquiring, erecting and maintaining telephone lines in the town of Westfield, to and through the town of Orleans and other places in the county. The incorporators are: W. A. Young, H. W. Burnham, H. D. Miller, of Westfield, Vt.; W. E. Brock and W. D. Miller, of Troy.

Personal.

DR. F. S. PEARSON, the well-known engineer and capitalist of New York, sailed for London on the steamer *Mauretania* on April 5.

MR. EUGENE CREED has resigned his position as sales manager of the Toronto Electric Light Company to accept a similar position with the Morris Iron Company, New York City.

MR. ANGUS S. HIBBARD, vice-president and general manager of the Chicago Telephone Company, has been elected a director of the Chicago Savings Bank & Trust Company.

MR. GEORGE B. ROBERTS was selected last week by the Electrical Commission of Baltimore to be assistant electrical engineer to Raleigh C. Thomas, the chief engineer of the subway department.

MR. K. A. ALBRECHT, electrical engineer, formerly with Kiewert & Company, has resigned and will sail on the steamer *Pretoria* on April 15 for Berlin, Germany, where he will hereafter reside.

MR. WILLIAM J. NORTON, first assistant secretary of the Public Service Commission, First District, New York, has resigned to enter the service of the Commonwealth Edison Company of Chicago.

MESSRS TORSTEN HOLMGREN, KNUT BILDT AND FREDRIK JONSON, of Sweden, who have been on a visit to this country, sailed on the steamer *Kronprinz Wilhelm* on April 11 for Sweden.

MR. J. S. VIEHE, formerly electrical engineer for the Rockingham Power Company at Pee Dee, N. C., has become associated with the Electric Bond & Share Company, New York, and is now in its engineering department.

MR. FRANK F. FOWLE, consulting engineer, Chicago, addressed the student engineering society of Northwestern University at Evanston, Ill., on April 4, his subject being "The Problems of the Engineering Graduate Upon Entering Practical Life."

PROF. ELIHU THOMPSON, of the General Electric Company, who has been touring southern California, on March 31 delivered to the students of Throop Polytechnic Institute an address in which he related a number of incidents regarding his early work in the electrical field.

MR. MAURITZ SAHLBERG, of Sweden, is on an extended visit to this country to study hydroelectric developments for the Department of Commerce of the Swedish government. Mr. Sahlberg has for ten years been a representative in Sweden for the Allgemeine Elektricitäts Gesellschaft of Germany.

MR. A. H. WHITESIDE, who recently resigned his position with the Allis-Chalmers Company to become associated with the Triumph Electric Company, Cincinnati, was previously Southern manager of the Sterling Boiler Company, with headquarters at Atlanta, Ga. He is a member of the Engineers' Club of New York and an associate member of the American Institute of Electrical Engineers. He assumed his new duties on April 1.

MR. JOHN G. GLASSCO has been appointed electrical superintendent of the Winnipeg (Man.) municipal generating station at Point du Bois, to be opened in July. Mr. Glassco was born in Hamilton, Ont., and after graduating as electrical engineer from McGill University, Montreal, became associated with the Kern River plant in California, leaving there in 1905 to become electrical engineer of the Dominion Power & Transmission Company at Hamilton, Can., where he remained until June, 1909, when he accepted an appointment on the construction staff of Smith, Kerry & Chace, engineers for the Point du Bois power plant.

MR. H. A. BURSON, who recently resigned as chief engineer of the Packard Electric Company, of St. Catharines, Ont., to become associated with the Canadian Crocker-Wheeler Company, Limited, at that place, graduated from McGill University in 1901 with the degree of B. S. and the following year received the degree of M. S. for special research work. After spending two years on the staff of the department of electrical engineering of McGill University he entered the engineering department of the Bullock Electric Company, of Cincinnati, specializing in the design of alternating-current apparatus under Mr. B. A. Behrend.

When the Allis-Chalmers-Bullock, Limited, of Montreal, was formed he was placed in charge of its electrical engineering department. In 1906 he severed his connection with Allis-Chalmers-Bullock to join the Packard Electric Company as chief engineer and general superintendent.

Obituary.

MR. WILLIAM C. WOODWARD, for twenty years connected with the Narragansett Electric Lighting Company, Providence, R. I., died at his home on March 25. Mr. Woodward was born in Roxbury, Mass., fifty years ago.

HON. L. J. FORGET, Senator, of Montreal, Que., a director of the Montreal Light, Heat & Power Company and president for many years of the Montreal Street Railway Company until control was acquired last November by the Robert-McConnell interests, died at Nice, France, on April 7. Senator Forget was born at Terrebonne, Que., on March 11, 1853, and was a prominent stockbroker at Montreal for twenty-five years, having founded the firm of L. J. Forget & Co. there in 1876. He was also prominent on the directorate of many institutions at Montreal. He is survived by a widow and four daughters.

HENRY GRADLE, M.D., one of the foremost oculists of Chicago, died at his winter residence in Santa Barbara, Cal., on April 4. Dr. Gradle took an intelligent interest in illumination and its effect on the eye, and for that reason was known to many electrical men in Chicago, by whom he was held in high esteem. He was a member of the Illuminating Engineering Society and had delivered addresses before the Chicago Section of that society and the Electric Club of Chicago. His scientific attainments were recognized and admired by his auditors. He was one of the comparatively few members of his profession who have shown a deep interest not only in the curing of eye troubles but also in their prevention.

MR. TOM LOFTIN JOHNSON, known as the "three-cent fare" Mayor of Cleveland, died at his home in that city on April 10, after an illness of more than one year. Mr. Johnson was born in Georgetown, Ky., on July 18, 1854. He began his business career as a clerk in a street railway office in Louisville, Ky., in 1869. He retained an interest in street railways throughout his life, having invented several street railway appliances. At different times he owned street railway property in Indianapolis, Cleveland, Detroit and Brooklyn. In 1891 he was elected to Congress, to which he was re-elected until 1895. From 1901 until 1910 he served as Mayor of Cleveland, when he became best known for his advocacy of a three-cent fare on the street railways

MR. GEORGE T. WESTCOTT, of Chicago, well known to electrical men throughout the Central West as a manufacturers' agent, died at Maywood, Ill., on April 2 from complications following an operation for stomach trouble. The son of one of the best known of Chicago's high-school principals, Mr. Westcott went direct from high school to the offices of the Western Electric Company in Chicago, where he earned repeated promotions, being for years first assistant to the purchasing agent. Leaving this post some five years ago, he entered the Chicago field as a manufacturers' agent for a number of Eastern firms catering to the electrical trade. Two years ago he was joined by Mr. G. D. Wilson, the business growing steadily under the firm name of Geo. T. Westcott & Company. He leaves a wife and daughter, and will be missed by many friends, who appreciated his sturdy sincerity and unfailing cheerfulness.

Trade Publications.

ELECTRIC SIGNS.—Signs of the reflector and flasher type are briefly described in leaflets issued by Veritys, Ltd., 28 King Street, Covent Garden, London, W. C., England.

ARC LAMPS.—Publication X124 of Veritys, Ltd., 28 King Street, Covent Garden, London, W. C., England, is devoted to flaming-arc lamps arranged for either interior or outdoor use.

INSULATION.—Insulating devices intended particularly for use with overhead trolley wires and contact rails for electric railroads are described in a booklet issued by the Randolph Insulator Company, 221 Murray Street, Newark, N. J.

ELECTRIC HEATERS.—In an illustrated catalogue and price list issued by Veritys, Ltd., 28 King Street, Covent Garden, London, W. C., England, various types of electric radiators, food warmers, kettles, glue pots, etc., are briefly described.

ELECTRIC FANS.—The Sprague Electric Company, 527 West Thirty-fourth Street, New York, has issued an attractive bulletin designated as Catalog No. 323, in which are illustrated, listed and briefly described numerous types of fans for the summer season.

DIRECT-CURRENT GENERATORS.—The Triumph Electric Company, Cincinnati, Ohio, has issued Bulletin No. 461, containing complete information concerning the constructive details of its engine-type direct-current generators, rated at from 30 to 1000 kw.

ELECTRIC SPECIALTIES.—The Central Electric Company, 320 Fifth Avenue, Chicago, Ill., has issued as its March price list an 84-page publication relating to switches, fuse boxes, sockets, attachment plugs, portable lamps and fixtures and numerous other electric lighting specialties.

ELECTRICITY IN IRRIGATION.—The Oregon Hydroelectric Engineering Company, Baker, Ore., has issued a booklet giving much information relating to the use of electric motors for driving irrigation pumps by the Harney Valley and Central Oregon Power & Irrigation Company.

STEAM BOILER OPERATION.—Bulletin No. 187 of the B. F. Sturtevant Company, Hyde Park, Mass., contains an article by F. R. Low entitled "Economical Fireroom Methods," which gives information relating to the theoretical and practical thermodynamic efficiencies of steam boilers.

AUTO TRANSFORMERS.—Auto transformers especially designed for use with low-voltage, high-efficiency metallic-filament lamps, arc lamps and for testing purposes are illustrated, listed and described in publication X125 of Veritys, Ltd., 28 King Street, Covent Garden, London, W. C., England.

MANUAL FOR BEGINNERS.—The Sangamo Electric Company, Springfield, Ill., has issued a pocket data book which contains a great deal of engineering information. The reference tables are conveniently arranged and the manual should prove of much value to mechanical and electrical engineers.

WESTINGHOUSE CATALOGS.—The Westinghouse Electric & Manufacturing Company has recently issued several new catalog sections, including the following: No. 228, Enclosed Fuse Blocks. No. 229, Subway Fuse Boxes. No. 553, Automatic Voltage Regulators. No. 731, Instrument Transformers. No. 735, Type S and SA Distributing Transformers

STEAM SPECIALTIES.—The Schutte & Koerting Company, Philadelphia, Pa., has issued a series of leaflets relating to various steam specialties. Section G of Catalog 7 deals with blast governors for Corliss engines, and Section L of the same catalog covers automatic engine lubricators. Section 5 of Catalog 8 is devoted to vacuum breaker valves, while grease extractors and feed-water filters are illustrated and described in Section E of this catalog.

MINE-VENTILATING FANS.—In a neatly illustrated catalog, designated as Publication No. 303, recently issued by the American Blower Company, Detroit, Mich., much information is given concerning the constructive details and operating characteristics of mine-ventilating fans. Much of the information in this catalog is of a technical nature, and it should prove of special value to operating and consulting engineers having to solve problems relating to the ventilation of mines.

ENGINE VALVE GEAR.—An ingenious model to illustrate the valve-timing gear in the Cochrane steam stack and cut-out valve water heater and receiver is being distributed by the Harrison Safety Boiler Works, of Philadelphia, Pa. The model is constructed of stiff celluloid. It serves to illustrate the fact that when the heater is cut off from the exhaust steam supply the separator is attached to and forms a part of the heater and continues to furnish exhaust steam to the heating system, while the stack is cut off from connection with the heater but still continues to drain the separator.

ELECTRIC SUPPLIES.—The Trumbull Electric Manufacturing Company, Plainville, Conn., has issued its No. 8, 1911, catalog describing its complete line of knife switches, covering all the regular sizes, styles and types of from 45 amp to 5000 amp, and for 250-volt and 600-volt direct-current and 440-volt alternating-current circuits. The line of porcelain material has been increased, and there has been an entire readjustment of panel-board material, a new feature being the listing of panel-board tables and steel and wood cabinets, complete with panels and slate frame. The catalog is bound in both paper and cloth.

ENGINE-DRIVEN ALTERNATORS.—Circular No. 1190, just issued by the Westinghouse Electric & Manufacturing Company, describes type "E" engine-driven, alternating-current generators from 50 to 1100 kva for operating on 60-cycle, 240-2400-volt circuits, which are arranged for direct mounting of the rotor on the shaft supplied with the prime mover. The makers claim that for moderate first cost, consistently satisfactory performance and low maintenance charges these machines are unsurpassed by any alternating-current generators on the market, and are peculiarly suited to conditions prevailing in isolated industrial plants and central stations of moderate capacity.

BUSINESS NOTES.

MR. J. S. JOSEPH has severed his connection as erecting engineer for W. A. Day & Company, First National Bank Building, Chicago, and has opened an office at 207 Union Bank Building, Chicago, as manufacturer's agent, handling contractors' equipment and supplies, locomotive cranes and grab buckets.

THE MORRIS IRON COMPANY, New York City, has been awarded the contract for furnishing poles for the ornamental lighting installation at Dallas, Tex. Magnetite arc lamps are to be used and the posts are to be of cast iron with steel shaft and ornamental crook, one lamp being used on each pole.

CANADIAN CROCKER-WHEELER COMPANY.—Mr. H. A. Burson, chief engineer of the Packard Electric Company, of St. Catharines, Ont., has resigned his position to accept that of commercial engineer with the Canadian Crocker-Wheeler Company, Limited, whose head office and works are located at St. Catharines, Ont.

YALE & TOWNE MANUFACTURING COMPANY.—Mr. C. H. Pearson, formerly with the Noera Manufacturing Company, of Waterbury, Conn., has become associated with the Yale & Towne Manufacturing Company to represent its hoist department throughout the Western States.

THE DONGAN ELECTRIC MANUFACTURING COMPANY will move on May 1 its main office and factory from Albany, N. Y., to 15 East Woodbridge Street, Detroit, Mich. The above company is placing upon the market a complete line of electrical measuring instruments, and its new location will greatly facilitate handling its rapidly increasing business. It will maintain branch offices at New York City, Birmingham, Ala., and Seattle, Wash.

TUNGSTOLIER COMPANY.—Mr. E. J. Kulas has severed his connection with the Central Station Development Company in order that he may give greater personal attention to other interests with which he is identified. Important developments in connection with the Tungstolier Company, of Conneaut, Ohio, of which he is president, are claiming much of his time and necessitate his retiring from active association with several other corporations in which he holds office.

THE GREGORY ELECTRIC COMPANY has let contracts for an addition to its works, Sixteenth and Lincoln Streets, Chicago, whereby the present storage space will be doubled. The addition will be of brick and steel construction of the same type as the present buildings. The floors will be heavy concrete. A brass foundry, etc., will be added and another 20-ton Whiting electric traveling crane installed, this making three electric cranes of the same make which will be in constant use at the works. The buildings will be completed about July 1.

THE NEW DEPARTURE MANUFACTURING COMPANY, Bristol, Conn., manufacturer of specialties, including a complete line of ball bearings, will open a western branch in the Ford Building, Detroit, Mich., on April 15. The company will maintain at this branch an engineering and sales force, which will be immediately available to the many customers in Detroit and the West. A full stock of all bearings of the company's manufacture will be carried at the branch. All of the important engineering data that have been accumulated by the company at the home office will also be on file.

CENTRAL ELECTRIC COMPANY.—The old quarters having proven unequal to the growing demands of its business, the Central Electric Company, of Chicago, has just completed changes which will nearly double its facilities. The offices are now on the top floor of its six-story building, where the arrangement of skylights will make artificial light unnecessary most of the time. The increase in floor space available for stock purposes, amounting to about 25,000 sq. ft., will enable the company to increase both the quantity and variety of its stock and work out in finer detail the system of stock-keeping and shipping.

GATES & BROWN.—Messrs. R. M. Gates and H. A. Brown have opened an engineering office at 1022 Citizens Building, Cleveland, Ohio, where they will specialize in consulting and designing work in mechanical and structural engineering. Mr. Brown has served in the engineering departments of the Browning Engineering Company, the Wellman-Seaver-Morgan Company, the Nevada Consolidated Copper Company and the Brown Hoisting Machinery Company. Mr. Gates has been associated with the Browning company and was until recently treasurer and general manager of the Victor Browning Engineering Company, of Cleveland.

TRIUMPH ELECTRIC COMPANY.—Mr. A. H. Whiteside, who was for over four years manager of the power and electrical department of the Allis-Chalmers Company, in charge of sales and engineering, has accepted a position as assistant sales manager with the Triumph Electric Company, of Cincinnati, Ohio. Mr. J. F. Nisbet, publicity manager of the Triumph Electric Company, has been selected to take charge of the publicity and advertising department of the Triumph Ice Machine Company also. These two departments were formerly operated independently of each other, but have recently been combined.

COLONIAL ELECTRIC COMPANY.—Mr. Alton Earle Williams has been elected secretary-treasurer of the Colonial Electric Company of Warren, Ohio, where he will be in charge of all the incandescent-lamp sales activities of that company. Mr. Williams has been connected with the general offices of the National Electric Lamp Association in Cleveland since the latter part of 1909, prior to which he was sales manager of the Brilliant Electric Company. Mr. Williams' work during the past few years has brought him into personal contact with many Western central-station men and also with prominent electrical jobbers all over the United States. His training and acquaintance will thus enable him to handle the commercial problems of the incandescent-lamp business from a broad and comprehensive standpoint. Mr. Williams is a member of the committee on improved wiring and equipment standards of the commercial section of the National Electric Light Association.

MOLONEY ELECTRIC COMPANY.—The new Canadian transformer factory of the Moloney Electric Company, of St. Louis, at Windsor, Ont., is now nearing completion. The company owns two acres of ground in Windsor and on it is building a modern factory which will have about 30,000 sq. ft. of floor area. The St. Louis factory has about 35,000 sq. ft. of floor space and has been working lately nearly up to its maximum output. The company has secured very large orders in Canada, and the new factory at Windsor will meet this demand. The Moloney Electric Company, which manufactures transformers, was established about fourteen years ago by Mr. Thomas O. Moloney, the president of the company. Mr. Moloney thought that the loss in the transformers of the period was excessive, and, as the possibilities of alternating-current distribution were largely dependent on better transformer efficiency, he determined to bend his energies to designing and making high-efficiency transformers. The present extensive establishment has grown from this modest beginning. Mr. Moloney continues to give his personal supervision to the business, although he has now a staff of competent assistants, prominent among whom is Mr. J. J. Mullen, the secretary of the company, of which Mr. J. P. Casey is sales manager.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 28, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

987,845. APPARATUS FOR THE ELECTRICAL TREATMENT OF LIQUIDS AND SEMI-LIQUIDS; V. M. Wright, Cleveland, O. App. filed Jan. 13, 1910. For treating cider, etc., to destroy germs by means of a cylindrical, horizontal vessel with a carbon bar within it and a series of electrodes in contact with the bar and a series of bars within the vessel for baffling the liquid while moving through the vessel.

988,198. ALARM FOR INCUBATORS; L. H. Litscher, Dayton, Ohio. App. filed July 28, 1909. Thermostatic damper giving an alarm when the temperature varies.

988,210. ART OF ELECTROLYTICALLY EXTRACTING METALS FROM THEIR ORES; W. D. Rennie, Hackensack, N. J. App. filed June 8, 1910. Agitates the electrolyte in which a powder of an ore is held in suspension when acted upon by the current.

988,245. OIL SWITCH; H. W. Cheney, Milwaukee, Wis. App. filed April 19, 1909. A frame to which a removable oil receptacle is secured containing contacts, a terminal extending through the frame and a separate connection which is made or broken when the receptacle is moved to or from its normal position.

UNITED STATES PATENTS ISSUED, APRIL 4, 1911.

988,298. ATTACHMENT PLUG; R. B. Benjamin, Chicago, Ill. App. filed March 13, 1908. For sockets receiving incandescent electric lamps, the base having an enlargement, an end contact, a side contact, the latter movable around the base and along the base, and being expanded when moved forward on the base.

988,308. INCANDESCENT LAMP; C. E. Campbell, Lynn, Mass. App. filed April 18, 1910. A filament lamp with filament support of heat-conducting material having a loop whose thin end penetrates the glass bulb and acts to dissipate the heat.

988,312. CONSTANT CURRENT REGULATOR; E. R. Cliff, New York, N. Y. App. filed Aug. 21, 1908. A core for a magnetic circuit having a central portion with outward arms and upwardly extending portions at their extremities composed of oppositely disposed and alternately arranged groups of U-shaped plates firmly bound together.

988,321. MINERS' AND THE LIKE ELECTRIC SAFETY LAMP; C. V. E. Eley and T. P. Brady, Birmingham, Eng. App. filed Nov. 18, 1909. Electric safety lamp having a battery, a circuit breaker controlled by a rod, the rod being moved by a spring with a ring within the glass shield so that when the shield breaks the circuit breaker is operated.

988,329. METHOD OF CONNECTING INCANDESCENT LAMP FILAMENTS WITH METALLIC CURRENT; L. Glaser, Pankow, Germany. App. filed April 10, 1907. Joins a lamp filament to a metallic conductor by softening the supply conductor by the passage of an electric current therethrough and applying pressure to bring the filament and conductor into contact.

988,337. BATTERY BOX; W. Henrichs, Moro, Oregon. App. filed Nov. 8, 1910. A holder for battery cells consisting of a box whose lid connects the cells of the battery by means of pole-engaging springs in the openings of the lower part of the lid.

988,340. UNIPOLAR EXCITER FOR TURBO-GENERATORS; H. Hertz, Chicago, Ill. App. filed June 3, 1907. A unipolar exciter having an armature located at the end of the rotor and mounted upon the end plate.

988,377. DYNAMO-ELECTRIC MACHINE; J. E. Noeggerath, Schenectady, N. Y. App. filed Sept. 23, 1909. Unipolar dynamo with an armature comprising a central disk or spider and an overhanging peripheral portion with axially extending flanges on opposite sides of the disk, cylindrical field frame members surrounding the shaft, circumferential field coils, collector rings on the periphery of the armature and collector rings on the shaft.

988,390. AUTOMATIC SELECTING SYSTEM; F. Schoenwolf, Chicago, Ill. App. filed May 6, 1907. A selective switch, a stationary switch, a stepping magnet for the switch, the switch having a ratchet and controlling pawl with means for reoperating the pawl when a partial step is made.

988,395. ALARM DEVICE; W. P. Stamps, Milvid, and William R. Philips, Munday, Texas. App. filed July 18, 1910. Wind gage which announces the approach of a storm by closing an electrical circuit at a given wind velocity.

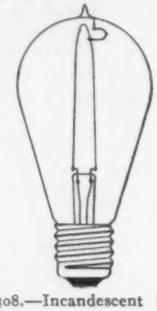
988,416. INCANDESCENT ELECTRIC LAMP; M. H. Welsh, Newark, N. J. App. filed March 16, 1910. A bulb, a straight filament therein supported on non-incandescent conducting supports, one of which has a thermostat portion transverse to the filament which when heated bends away from the other support so as to keep the filament taut.

988,440. ELECTRIC CIRCUIT CONTROLLER; E. J. Burke, New York, N. Y. App. filed Nov. 9, 1909. Selective system for telephone and telegraph calls, including a traveler actuated by gravity and moving over a plurality of contacts, the traveler being arranged on an inclined way so as to cause the gravity-actuated device to complete one or more circuits.

988,441. AUTOMATIC VOLTAGE REGULATOR; G. A. Burnham, Essex, Mass. App. filed Sept. 7, 1909. A voltage regulator with a common vibrating contact member, two contacts, mechanism for raising the voltage or for lowering the voltage and a vibrating contact member for coöperating with the two contacts.

988,442. AUTOMATIC VOLTAGE REGULATOR; G. A. Burnham, Cliftondale, Mass. App. filed Sept. 30, 1910. Two contacts which are given a make and break movement and one moved at high speed so as to give a shearing movement when separated.

988,465. ELECTRIC SIGNALING SYSTEM; J. S. Harley, Minneapolis, Minn. App. filed May 16, 1910. Electric signaling system for fire alarms having a main circuit, branches of grouped annunciators and a shunt circuit, including signaling means for indicating a deficiency of current in the main circuit.



988,308.—Incandescent Lamp.

988,456. POTENTIOMETER; H. Grensbach, New York, N. Y. App. filed Dec. 7, 1910. For wireless telegraphy, the potentiometer having a dished face carrying a scale with thumb-piece and indicator bars of high-resistance in the bottom face which contact with the screw.

988,461. CONNECTION BOX FOR ELECTRIC CONDUITS; J. E. Graybill, York, Pa. App. filed July 29, 1908. Box for electric wire conduits comprising a plurality of sections forming a tubular conduit at one end and having interlocking means at the other with locking means releasably securing the tubular ends together.

988,507. LAMP SOCKET SWITCH; H. E. Reeve, New York, N. Y. App. filed May 14, 1910. An electric switch with light spring contact arms, a porcelain cam between the arms, a power spring for supplying the power to effect a quick break of the circuit.

988,518. ELECTRICAL CONNECTOR; C. M. Steiner, Pittsburg, Pa. App. filed July 9, 1910. A body with threaded sleeve and yielding finger carried by the sleeve for effecting a locking engagement between the sleeve and the body. Designed particuarly for plugging into lamp sockets.

988,534. MECHANICAL MOVEMENT FOR END CELL SWITCHES; J. W. Achard, Philadelphia, Pa. App. filed June 21, 1910. A pair of interconnected cams rotatable in either direction with a pivotal follower having a pair of pawls coöperative with the cam, a buffer, stops and a spring for the buffer.

988,571. ROTARY CIRCUIT BREAKER; S. T. Hutton, Chicago, Ill. App. filed Aug. 19, 1910. For rapidly interrupting the circuit by means of a rotary vessel containing mercury forming one terminal, the vessel having downwardly converging walls with an annular channel midway and a rotating insulating disk excentrically mounted within the vessel and carrying a contact.

988,695. ELECTRICALLY HEATED OVEN; F. J. Cook, Collinwood, O. App. filed Aug. 31, 1909. Heating oven made up of stones with a channeled edge and holes and a heating wire threaded through them.

988,706. TELEPHONE RECEIVER SHELL; J. Halldow, Elyria, O. App. filed Oct. 8, 1908. A body with a cap, the cap having a perforated member shaped to communicate sound waves from the receiver to the ear with a threaded ring engaging the receiver cap. The receiver is made of sheet metal.

988,711. CENTRAL TELEPHONE SYSTEM; J. D. Holmes, Pasadena, Cal. App. filed July 14, 1909. Telephone central exchange with cord circuit having a busy testing system in connection with the operator's instrument, there being means in the busy circuit controlled by an electric magnet for controlling a local circuit through the operator's instrument.

988,732. ALARM DEVICE; V. J. Niele, Pittsburg, Pa. App. filed Feb. 12, 1910. A suction disk carries the contacts for a local bell circuit and can be attached to the face of the clock dial so that its contacts are closed by the hand of the clock.

988,754. TROLLEY; C. H. Bierbaum, Buffalo, N. Y. App. filed May 13, 1907. Trolley wheel with a hub carrying two disks engaging a bearing ring and a wire independent of the other mechanical connections between the ring and the hub connected with the hub and with the ring.

988,767. ELECTROLYTIC INTERRUPTER; H. Gernsback, New York, N. Y. App. filed Feb. 12, 1910. A receptacle with cover carrying a tube of insulating material having an aperture in the bottom and anode passing through the cover resting within the aperture and closing it normally and a cathode secured to the cover having an angularly disposed lower end below the anode.

988,768. SPRINKLER ALARM SYSTEM; A. Goldstein, New York, N. Y. App. filed Dec. 3, 1910. For giving an alarm after the sprinkler has extinguished the fire to prevent further damage by water. The signal is controlled by stopping the flow of water, a water-wheel actuated by the flow controlling the signal.

988,792. METHOD AND MEANS OF PRODUCING SYNCHRONISM BETWEEN THE ROTATION OF A CONTROLLING MACHINE AND THE ROTATION OF ONE OR MORE ELECTRICALLY DRIVEN MACHINES; E. L. A. Lertourne, Rouen, France. App. filed Aug. 24, 1909. A controlling machine with a rotary distributor, a dependent machine driven by an electrical motor and driving a rotary receiver and electrical circuits which include the successive contacts of the distributor and receiver, together with resistances carried by the rotary distributor which permit the passage of current to control signals.

988,811. TELEGRAPHY; L. M. Potts, Baltimore, Md. App. filed July 1, 1908. A duplex telegraph line with an instrument giving a correct adjustment of the artificial line at a given station, responsive to current from a distant station only. The line is operated duplex at a fraction of its full capacity without the use of the artificial line and the artificial line is adjusted during this time.

988,819. TELEPHONE TRANSMITTER; C. R. Rogers, Waverly, N. Y. App. filed Jan. 28, 1910. Mouthpiece with a flange forming a chamber between diaphragm and mouthpiece, the chamber containing an antiseptic.

988,821. ELECTRIC SWITCH; J. R. Rossignol, Savannah, Ga. App. filed March 12, 1910. An electric switch with spaced contacts, a sliding contact, an operating lever carrying a curved projection and an annular spring fixed at one end and free at the other bearing against the projection.

988,859. ELECTRIC LOW-LEVEL SIGNAL FOR GASOLINE TANKS; O. C. Carr, Lansing, Mich. App. filed March 19, 1910. An electric signal including a circuit closer operated by a float in the gasoline tank.

988,862. HUMAN CREMATORY; J. Conley, Anadarko, Oklahoma. App. filed July 1, 1910. For cremating human bodies by means of arcs produced by groups of three or more electrodes radially projected into the cremating chamber.

988,873. ELECTRIC FUSE CARTRIDGE; J. Grohowsky, Plymouth, Pa. App. filed Aug. 8, 1910. An insulating tube with a disk at each end, terminals on the disk and a fusible conductor secured to the terminals.

988,876. TELEPHONY; I. Kitsee, Philadelphia, Pa. App. filed June 4, 1907. A vibrating diaphragm, an inductorium having a primary and secondary, the number of inducing convolutions of the primary being controlled by a diaphragm.

988,877. MEANS FOR CONNECTING SENSITIVE RELAYS; I. Kitsee, Philadelphia, Pa. App. filed Dec. 29, 1908. Prevents chattering of the relay contacts by means of auxiliary circuits and relays, the second relay actuating a signal-transmitting instrument and being controlled by the contacts of the first relay.

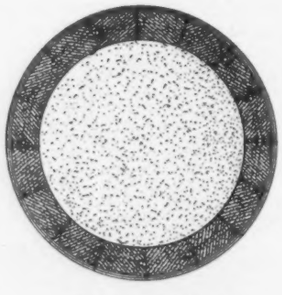
988,878. CABLE TELEGRAPH SYSTEM; I. Kitsee, Philadelphia, Pa. App. filed April 23, 1909. A line or cable of great capacity on which continuous current impulses are impressed. Means are provided for impressing signaling impulses thereon and for neutralizing the effects upon the receiver of the continuous impulses and the signal impulses.

988,879. TELEGRAPHY; I Kitsee, Philadelphia, Pa. App. filed July 8, 1909. The method of differentiating between a dot and dash in cable telegraphy by impressing upon the line for each character an impulse of substantially equal duration and intensity irrespective of the polarity and prolonging one character impulse by an impulse of the same polarity but lower electromotive force.

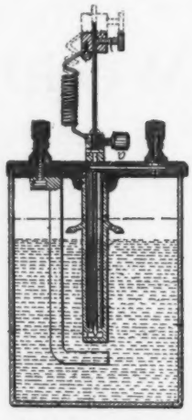
988,891. ELECTRIC FUSE TESTING DEVICE; C. W. Mitchell, Brooklyn, N. Y. App. filed June 28, 1910. For determining which of the fuses on opposite sides of the line circuit has been blown by an overload, where inclosed non-arcing fuses are employed. Provides a lamp within a protected casing with contact posts to test the fuse.

988,906. RECEIVER CASING; L. Steinberger, New York, N. Y. App. filed May 25, 1910. Magnet receiver casing for telephones having two protecting rings, one at each end to sustain the receiver out of contact with the surface upon which it is placed.

988,907. MOUTHPIECE; L. Steinberger, New York, N. Y. App. filed Aug. 6, 1910. A body portion with a thick massive floor having air passages of conical shape opening in front of the diaphragm.



988,695.—Electrically Heated Oven.



988,767.—Electrolytic Interrupter.

988,916. MOTOR FOR DYNAMO-ELECTRIC MACHINES; H. H. Wait, Chicago, Ill. App. filed Jan. 28, 1907. For supporting the winding against centrifugal strain by means of longitudinal and circumferential grooves which contain the winding with longitudinal and circumferential keys.

988,934. OXID PLATE FOR PRIMARY BATTERIES; J. W. Gladstone, West Orange, N. J. App. filed Nov. 8, 1904. Has a wedge-shaped protecting edge of greater density than the interior so as to prevent the edge from chipping.

988,936. ELECTRIC FURNACE PROCESS AND ELECTRIC FURNACE; C. Hering, Philadelphia, Pa. App. filed July 6, 1909. The resisting element includes molten material in column form of a special cross-section, so that the molten material is automatically agitated, the ratio of the square of the furnace current transmitted through the column to the cross-section of the column being great.

988,955. RELAY; J. B. Struble, Wilkinsburg, Pa. App. filed Feb. 2, 1910. Slow release relay for railway signaling system, particularly for use in polarized or wireless track circuit. The armature has a movement to two positions and mechanism is interposed between the armature and the contact for closing the contact when the armature is moved, and a retarding device holds the contact closed while the armature moves from one to the other position.